

Camera Link Frame Grabber

User's Manual



V1.0.0

Foreword

This manual introduces the installation, functions, and configuration of the device. Read this manual before you use the product and keep this manual for future reference.

Model

GCL-5F20E, GCL-5F21E

About this product

This product can only enjoy after-sales service and maintenance in the country or region where it was purchased.

Disclaimer

To the fullest extent permitted by law, this manual and the products described (including their hardware, software, firmware, and more) are provided "as is", and might contain defects or errors. We disclaim all warranties of any kind, either express or implied, including but not limited to, warranties of merchantability, satisfactory of quality, and fitness for a particular purpose, and shall not be liable for any special, incidental, consequential, or indirect damages arising out of the use of this manual or the use of our products, including but not limited to, damages resulting from loss of business profits, system failure, or loss of data or documentation.

- When using this product, please follow the applicable laws and regulations strictly to avoid infringing the rights of third parties.
- If the data covered in this manual may vary due to environmental or other factors, we shall not be liable for the consequences thereof.
- If the contents of this manual conflict with applicable laws, the legal provisions shall prevail.

Safety Instructions

The following signal words might appear in the manual.

Signal Words	Meaning
 DANGER	Indicates a high potential hazard which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a medium or low potential hazard which, if not avoided, could result in slight or moderate injury.
 CAUTION	Indicates a potential risk which, if not avoided, could result in property damage, data loss, reductions in performance, or unpredictable results.
 TIPS	Provides methods to help you solve a problem or save time.
 NOTE	Provides additional information as a supplement to the text.

Revision History

Version	Revision Content	Release Time
V1.0.0	First release.	August 2023

Privacy Protection Notice

As the device user or data controller, you might collect the personal data of others such as their face, fingerprints, and license plate number. You need to be in compliance with your local privacy protection laws and regulations to protect the legitimate rights and interests of other people by implementing measures which include but are not limited: Providing clear and visible identification to inform people of the existence of the surveillance area and provide required contact information.

About the Manual

- The manual is for reference only. Slight differences might be found between the manual and the product.
- We are not liable for losses incurred due to operating the product in ways that are not in compliance with the manual.
- The manual will be updated according to the latest laws and regulations of related jurisdictions. For detailed information, see the paper user's manual, use our CD-ROM, scan the QR code or visit our official website. The manual is for reference only. Slight differences might be found between the electronic version and the paper version.
- All designs and software are subject to change without prior written notice. Product updates might result in some differences appearing between the actual product and the manual. Please contact customer service for the latest program and supplementary documentation.
- There might be errors in the print or deviations in the description of the functions, operations and technical data. If there is any doubt or dispute, we reserve the right of final explanation.
- Upgrade the reader software or try other mainstream reader software if the manual (in PDF format) cannot be opened.
- All trademarks, registered trademarks and company names in the manual are properties of their respective owners.
- Please visit our website, contact the supplier or customer service if any problems occur while using the device.
- If there is any uncertainty or controversy, we reserve the right of final explanation.

Important safeguards and warnings

This chapter introduces how to use the product in a proper manner. To prevent hazards and property damage, read the following requirements before you use the product and comply with the requirements when you use the product.

Transportation requirements



- Pack the device with packaging provided by its manufacturer or packaging of the same quality before transporting it.
- Do not place heavy stress on the device, violently vibrate or immerse it in liquid during transportation.
- Transport the device under allowed humidity and temperature conditions. Refer to the technical parameters for requirements on the temperature and humidity that is suitable for transporting the device.

Storage requirements



- Store the device under allowed humidity and temperature conditions. Refer to the technical parameters for requirements on the temperature and humidity that is suitable for storing the device.
- Do not place heavy stress on the device, violently vibrate or immerse it in liquid during transportation.

Installation requirements



WARNING

- Make sure that the power is off when you connect the cables, install or disassemble the device.
- For devices with earthing systems, make sure they are grounded to avoid their being damaged by static electricity or induced voltage, and the risk of electrocution.
- All installation and operations shall conform to local electrical safety regulations.
- Use the accessories suggested by the manufacturer. Installation must be performed by qualified professionals.
- Install the device in a well-ventilated place, and do not block its ventilation.
- Do not put the device in a place near the heat source, such as radiator, heater, stove or other heating device, which is to avoid the risk of fire.
- Do not place the device in the humid, dusty, extremely hot and cold site with strong electromagnetic radiation or unstable illumination.
- Do not place heavy stress on the device, violently vibrate or immerse it in liquid during transportation.



WARNING

Safe and stable power supply is a prerequisite for proper operation of the device.

- Make sure that the ambient voltage is stable and meets the power supply requirements of the device.
- Protect the power cord and wires from being stepped on or squeezed, especially at plugs, power outlets, and contacts leading from the device.
- Do not connect the device to two or more kinds of power supplies, to avoid safety risks and damage to the device.
- Refer to the manual of the device for the power supply requirements.



- The frame grabber is a static sensitive device. Before removing the frame grabber, touch your hand with a metal grounded object (for example, grounded PC host chassis) to discharge static electricity. When you take out the frame grabber, you can temporarily place the frame grabber on an anti-static bag, and do not contact the frame grabber with felt, silk and other fabrics that are prone to static electricity.
- Before installing the frame grabber, you need to power off the host, unplug the host AC power input, and wait for the motherboard to finish discharging. Generally wait 1–2 minutes to complete the discharge. For the motherboard with power indicator, you need to wait for the power indicator on the motherboard to turn off before operation.
- When inserting the frame grabber, hold the bending position of the frame grabber's baffle in one hand, and hold its upper edge (the position above the on-board trigger interface) in the other hand. Insert the grabber vertically from top to bottom, and check whether the back plate of the frame grabber is reliably lapped with the EMC shrapnel of the chassis. After inserting the grabber into the chassis, use the screws to fix the back plate. During operation, do not shave the frame grabber from side to side, and avoid bumping between the frame grabber and the internal components of the host computer. Do not use your fingers to touch the lower edge of the frame grabber and the motherboard contact gold finger parts, to avoid contaminating the contact surface, resulting in poor contact.
- The frame grabber is designed to take the natural convection heat dissipation method. You need to leave enough space around the frame grabber for normal heat dissipation. For example, if the motherboard has more than one available PCIe slot, it is recommended that you separate the frame grabber and other boards with one slot during installation.
- When placing the host chassis, reserve enough space on the back plate area of the frame grabber for the cable, and reserve enough bending radius for the cable. If the bend radius is too narrow, it will put extra force on interfaces of the frame grabber and damage the interfaces.

Operation requirements



A suitable operating environment is necessary for the device to work properly. Confirm whether the following conditions have been met before use.

- Use the device under allowed humidity and temperature conditions. Refer to the device label for information on the operating temperature and humidity of the device.
- Use the device on a stable surface.
- Do not allow liquid to get into the device to avoid damage to the internal components. If any liquid flows into the device, immediately disconnect the power supply, unplug all the cables connected to the device, and contact after-sales service.
- Do not plug and unplug external interfaces such as CameraLink with electricity, otherwise the port may be damaged.
- Do not plug and unplug the PCIe board with electricity.
- Back up the data regularly during deployment and use, in an effort to avoid data loss caused by malfunctions in the operation of the device. We are not liable for data security.
- We are not responsible for any damage incurred to the device due to the excessive or improper use of the device.

Maintenance requirements



WARNING

- Have qualified professionals regularly perform inspections and maintenance on the device. Do not disassemble or dismantle the device without a professional on site.
- Use the accessories suggested by the manufacturer. Maintenance must be performed by qualified professionals.

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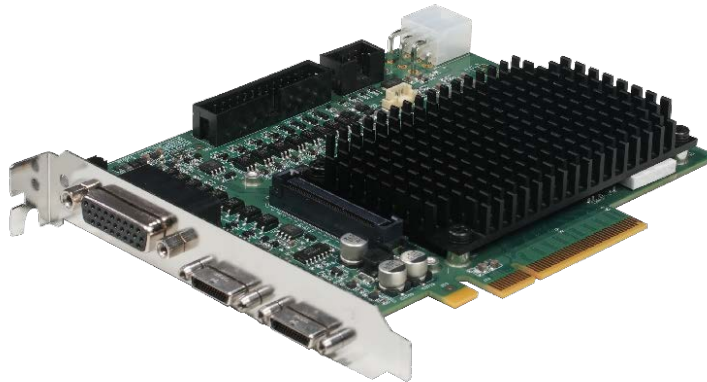
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1 Overview

1.1 Introduction

The Camera Link digital image frame grabber is developed and designed to meet the ever-increasing resolution and faster frame rate of today's camera technology. It fully uses the PCIe bus to transfer data and supports PCIe Gen2 standard, which enhances the performance and flexibility of traditional image acquisition and processing technology to a new level. It supports line scan, area scan, color, and mono cameras, suitable for a variety of medium and high-end vision application systems.

Figure 1-1 Appearance



1.2 Features

- Supports 20–85 MHz pixel clock.
- Support Base/Medium/Full/80-bit.
- Supports multiple IO interfaces, and integrates multiple inputs and outputs.
- Provides SDK to support GenTL protocol, which is convenient for secondary development.
- Conforms to GenIcam protocol standard.
- Supports CameraLink 2.0 protocol, with a theoretical maximum speed of up to 6.8 Gbps.

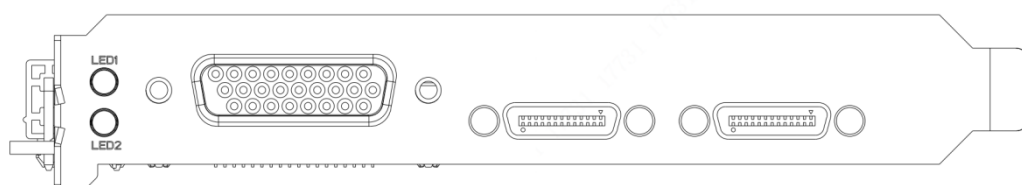
1.3 Environment requirements

- Temperature and humidity.
 - ◇ Operating temperature: 0 °C to + 50 °C, 10%–90% RH, non-condensing.
 - ◇ Storage temperature: -20 °C to + 70 °C, 10%–90% RH, non-condensing.
- The device is mounted in the bay in a stable position. Leave enough space for heat dissipation at the front and back.
- Ensure some air flow.

1.4 Status indicator

There are 2 red and green indicators next to the IO interface of the frame grabber, which are used to indicate the communication status of the frame grabber.

Figure 1-2 external status indicator

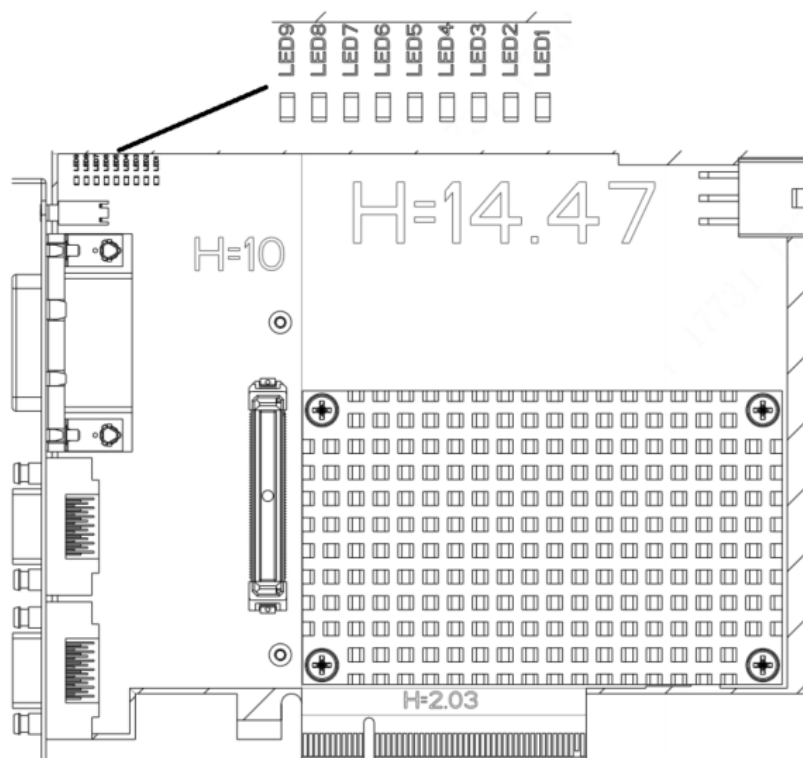


The status indicator of the device is shown in the following table.

Table 1-1 External status indicator

Indicator Status	Description
Red light stays on	The frame grabber failed to detect the camera.
Green light stays on	The frame grabber detects the camera but does not transmit data.
Green light flashes quickly	The frame grabber detects the camera and is connected normally.
Green and red indicators stay on	In the Full and 80-bit modes, the CL1 and CL2 cables are reversed.
Green and red flash	The frame grabber firmware is being updated.

Figure 1-3 Internal status indicator



The frame grabber has 9 LED indicators inside, which can show the working status of the frame grabber in real time.

Table 1-2 Internal status indicator

Name	Indicator Status	Description
LED1	Always off	Reserved
LED2	Red light flashes	DDR initialization succeeded
LED3	Red light stays on	Frame grabber power supply is normal
LED4	Solid green light	FPGA loaded successfully
LED5	Solid green light	FPGA loaded successfully
LED6	Always off	Reserved
LED7	Red light flashes	PCIe connection succeeded
LED8	Always off	Reserved
LED9	Red light flashes	PCIe clock exists

1.5 Product matching plan

Table 1-3 Product Matching Programs

Camera: CameraLink interface camera described in this manual.

Table 1-3 Product matching plan

Camera: CameraLink interface camera described in this manual.
IO trigger cable: standard D-SubB26 interface trigger cable, used for accessing external trigger signals and frame grabber IO output.
CameraLink cable: used for signal transmission between CameraLink cameras.
Synchronization cable: used for signal transmission between main and sub cards.

1.6 CameraLink frame grabber configuration

The Camera Link interface has been undergoing various upgrades and modifications to adapt to the increasing demand for data throughput. As a result, Base, Medium, Full and Deca versions are available on the market. They can transmit data at different rates, and some of them can even use 2 cables for transmission as needed.

- Base: The Camera Link configuration transmits signals over a single connector or cable. The cable used is an SDR 26-pin male plug connector optimized by 3M for LVDS signals. In addition to the 5 LVDS pairs (24 bits of data and 4 framing or enable bits) that transmit the serial video data, the connector has 4 LVDS discrete control signals and 2 LVDS asynchronous serial communication channels for communication with the camera. At the maximum chipset operating frequency (85 MHz), the base setup produces a video data throughput of 2.04 Gbit/s (255 MB/s).
- Medium and Full: The Camera Link specification includes higher bandwidth configurations that provide an additional video data path via a second connector or cable. The Medium configuration doubles the video bandwidth by adding 24 bits of data and the same 4 framing/enabling bits to the Base configuration. This produces a 48-bit wide video data path with a throughput of up to 4.08 Gbit/s (510 MB/s). The Full configuration adds another 16 bits to the data path, resulting in a 64-bit wide video path that can carry 5.44 Gbit/s (680 MB/s).



For example, if Base=Channel Link, then Medium=Base+Channel Link, and Full=Base+2 Channel Link.

- Deca: With the further development of camera technology, the original Camera Link Full standard has not been able to meet the image acquisition requirements of some ultra-high resolution cameras, so the 8 unused bits in the Camera Link Full standard are reallocated and utilized, and the new standard DecaCamera Link comes. The Deca standard can generate a data path width of 80 bits over 2 connectors or a second cable, which greatly expands the data bandwidth and is capable of carrying 6.8 Gbit/s (850 MB/s).

Currently the industrial-leading camera manufacturers use the term Camera Link Deca to denote cameras and image frame grabbers that are compatible in this mode. However, some manufacturers use the term Extended Full to refer to Deca configurations, and even some manufacturers still use the term Camera Link Full to describe Deca mode. This may cause misunderstanding to some customers when choosing a camera.

2 Installation

2.1 Installation

To avoid damaging the frame grabber, please power off the host before installing the frame grabber. Power on the host after the installation is completed to ensure the normal operation of the frame grabber.

1. Turn off the power of the host computer.
2. Insert the grabber into the PCIe2.0 x4 or x8 or more slot of the host computer.
3. Secure the front bezel of the frame grabber and the host computer with screws.
4. Ensure that the camera is not connected to a power source, and use the correct Camera Link cable to connect the camera to the frame grabber's Camera Link SDR port. Depending on the actual need, you can choose to connect a single camera or multiple cameras.

2.2 Download the MV Viewer software

Log in to our official website, select the software category (machine vision industrial camera client MVviewer (CL)), and download and install it to your computer.

Manual path (default): C:\Program Files\HuarayTech\MV Viewer\Documentations

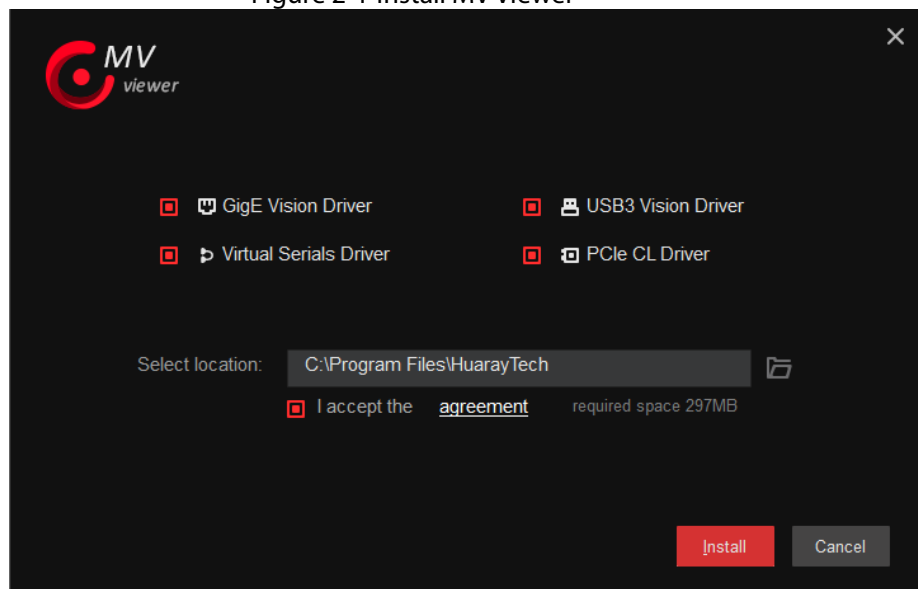
Driver file path (default): C:\Program Files\HuarayTech\MV Viewer\Drivers

Access in different languages and routine path (default): C:\Program Files\HuarayTech\MV Viewer\Development\Samples

2.3 Install the MV Viewer software

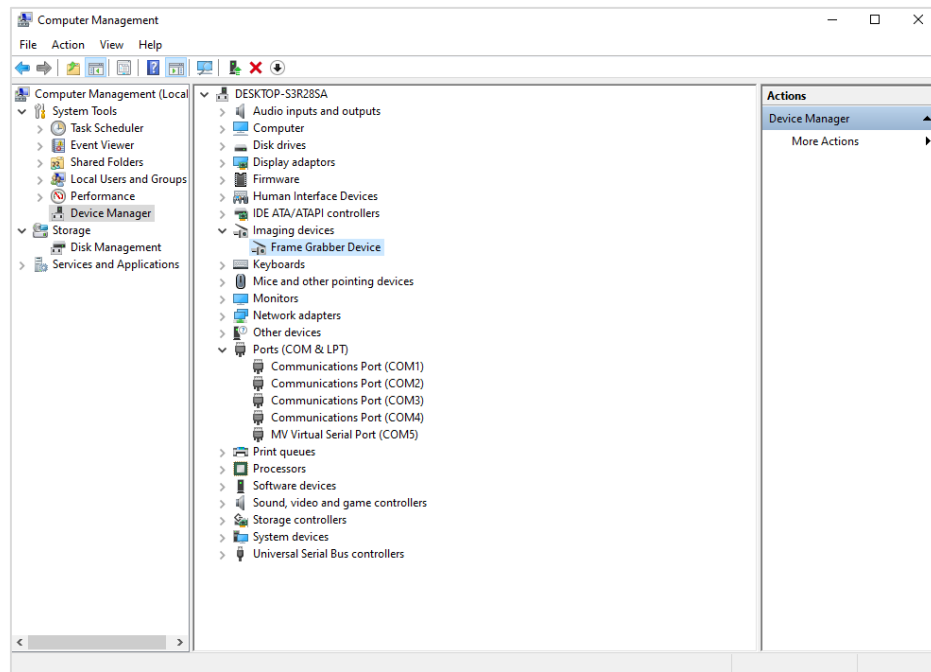
- Step 1 Install the MV Viewer software. If there are other MV versions on the current computer, uninstall them first.
- During the software installation process, a pop-up box appears in MV Viewer. Ensure that the virtual serial port driver and the CL driver are selected, and you can select other drivers as needed.

Figure 2-1 Install MV Viewer



- Step 2 Check whether the driver is installed successfully.
- Right-click **My Computer**, and then click **Manage**, open **Device Manager** and locate the port (MVVirtual Serial Port) and the image device (Frame Grabber Device).

Figure 2-2 Computer management



2.4 Frame grabber and camera configuration

Figure 2-3 MV main page

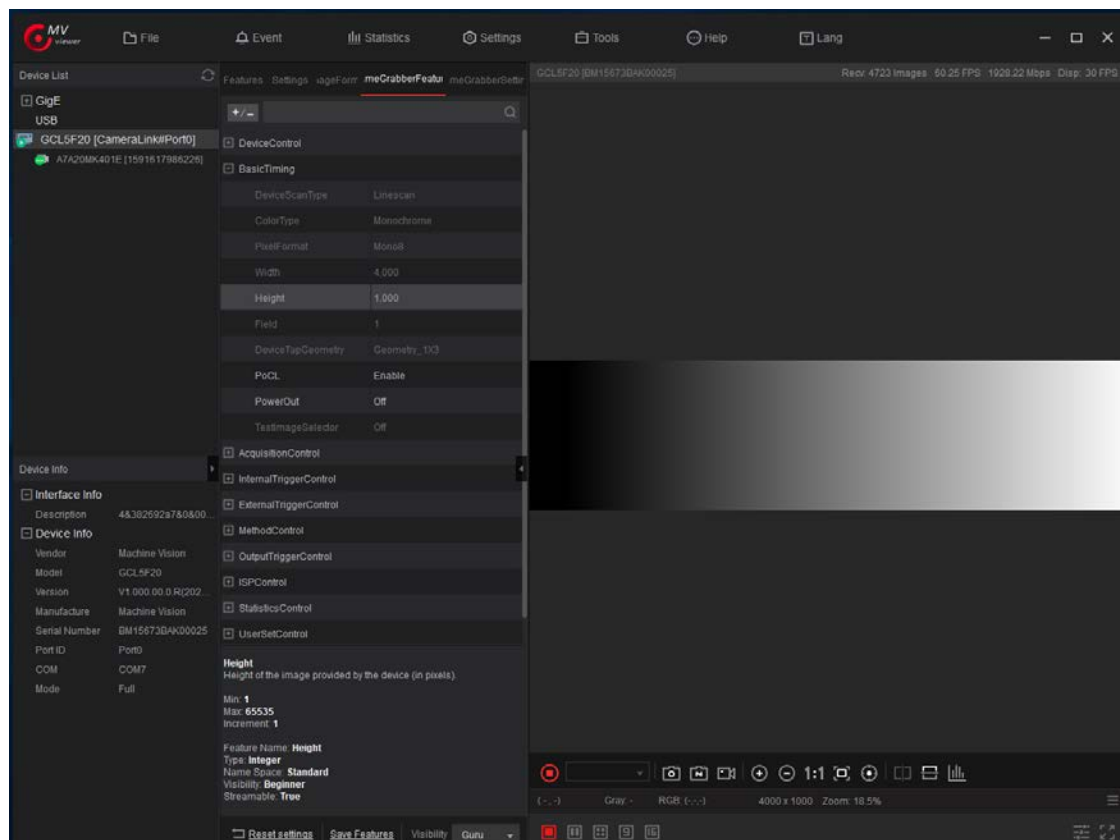


Table 2-1 Description

No.	Parameter	Description
1	Menu Bar	For more information, see the following table.
2	Device list	Includes GigE, USB, CameraLink, and PCIe. 🔄: Refresh online devices.

No.	Parameter	Description
		: Device can be connected. : The device is connected. One MV Viewer can be connected to a camera at the same time.
3	Device information	Select a device, and then you can view its interface and device information.
4	Parameter information	/ : Display or hide the parameter information.
5	Function	Select and configure specific function parameters.
6	Operation level	- Restore factory settings: click to restore all parameters to factory settings. - Save properties: click save current parameter changes. - Operation level: you can click to select junior, expert or master from the drop-down list. The parameters of each role are slightly different.
7	Window menu	/ / : maximize, restore, and minimize the window. : close MV Viewer.
8	Tool bar (some functions of the CameraLink line scan industrial camera that involve the image display function cannot be used on the MV. You need to set and display the image on the software provided by the frame grabber manufacturer)	/ : play/stop. You can click and select the play mode of continuous, single frame, and multi-frame from the drop-down menu as needed. You can only select play mode when the video is paused. / : Save one or multiple pictures. / : Zoom in/out the screen. / : Displays the video image 1:1/by window size. When the image is zoomed in or out, click to display the video image according to the actual window size. / : The mirror of image in the vertical or horizontal direction.



You can only perform operations only after you pause or stop the image.

Table 2-2 Menu bar description

Menu		Note
File	Open file	Select File > Open File , select a file in the pop-up window, and click Open .
	Open recent file	Select File > Open Latest . The software displays the 10 files that you have recently used in the MV Viewer. Click the name of a file to open it.
	Save	Save changes to the current file.
	Save as	Save the current file with another name to another path.
Event notification		Notifications for events such as device parameter change, event message channel and stream cache.
Statistics		Make statistics of acquisition frame rate, bandwidth, number of accepted images, frame loss rate, and number of error images.
Setting	General Settings	You can configure camera operation level and basic parameters on the client.
	Image saving	Set the image storage path and image format.
	Video recording	Set the video storage path and video format.
	Cache options	Set the cache parameters for video stream data.
	Transmission control	Set parameters such as command response timeout, heartbeat interval, and stream packet timeout.

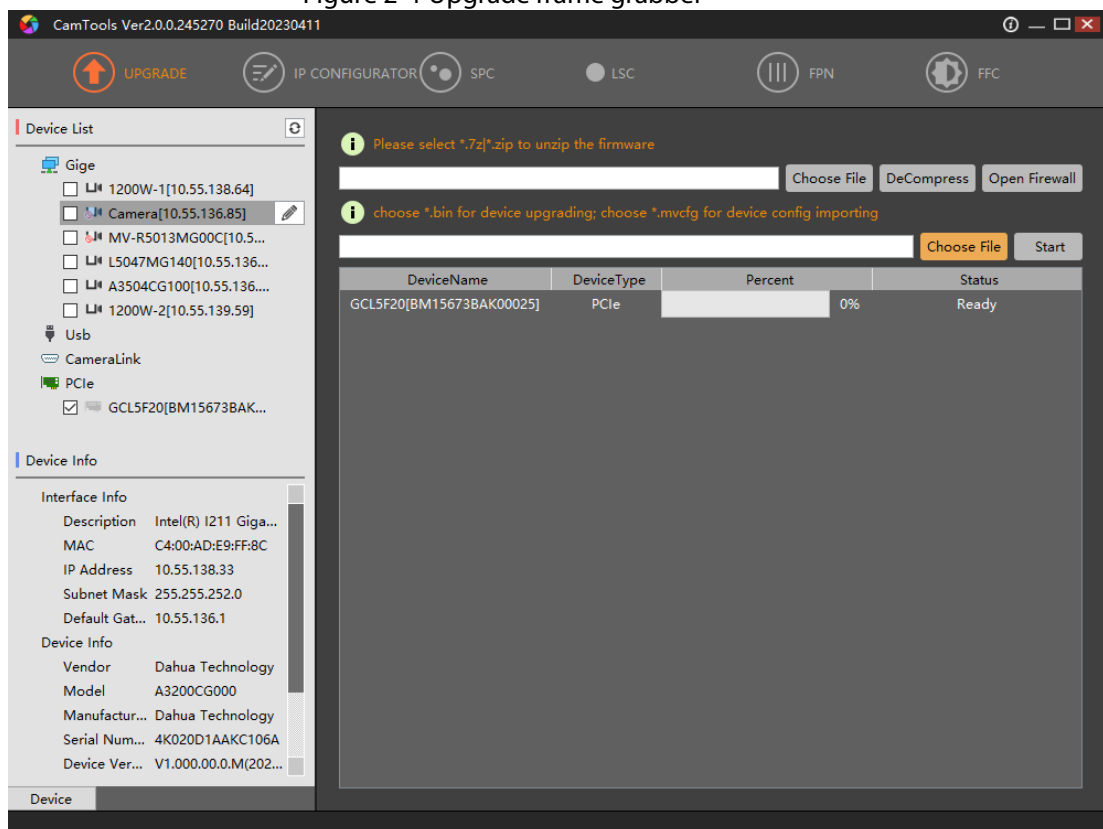
Menu		Note
Tools	Frame grabber camera tools	You can upgrade firmware, configure camera IP address, and more.
	Driver management tool	Install or uninstall the MV Viewer basic driver on your computer.
	Network adapter configuration tool	Switch network adapters and configure parameters of network adapters.
	CameraLink configuration tool	You can view the the device name and and edit the the baud rate.
Help		View the current software version information.

2.4 Upgrade frame grabber

Before upgrading the frame grabber, disconnect the frame grabber, and prepare the frame grabber upgrade program (. bin). The specific operations are as follows:

- Step 1** Select **Tools > Frame grabber camera tools** in the menu bar, and the CameraTools will pop up on the page.
- Step 2** On the left-side device list of the CameraTools, select the frame grabber to be upgraded.
- Step 3** Find the firmware upgrade bar on the right, click **Select**, find the target upgrade program (*. bin) in the pop-up box, and then click **Start**.
- Step 4** Wait until the upgrade is completed.

Figure 2-4 Upgrade frame grabber



After the upgrade of the frame grabber is complete, you need to turn off the computer first and then start it.

2.5 Structure dimensions

Figure 2-5 Main view of frame grabber

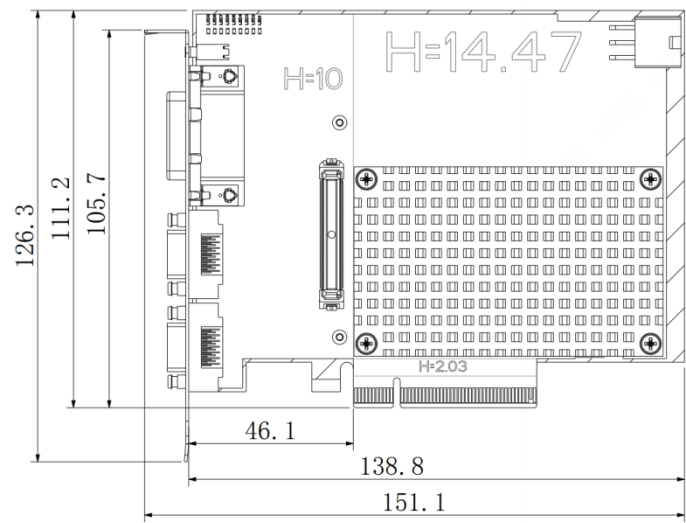
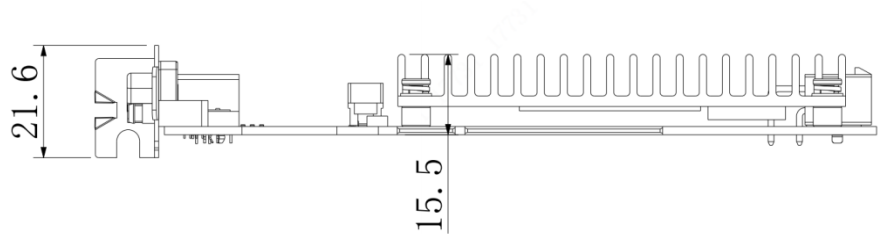


Figure 2-6 Left view of frame grabber

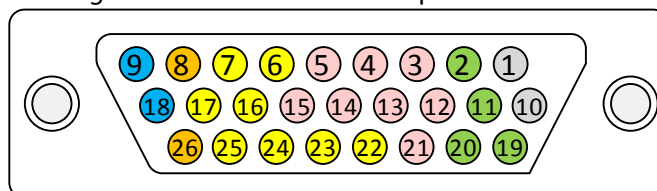


3 I/O

3.1 Panel trigger interface description

The panel trigger interface is 26-core 3-row high-density male seat D-Sub connector, and the connector pin definition is as follows:

Figure 3-1 D-SUB 26 interface pin definitions



- =Signal ground
- =Differential input
- =Power ground
- =Single-ended input
- =Power
- =Single-ended output

The signal definition of D-Sub connector is as follows:

Table 3-1 D-SUB 26 connector signal definitions1

Pin	Signal	Direction	Usage
1	GND	–	Signal ground
2	DIN_B+	Input	High-speed differential input 2 (normal phase)
3	OPT_IN1+	Input	Isolated input 1 (positive)
4	OPT_IN3-	Input	Isolated input 3 (negative)
5	OPT_IN4-	Input	Isolated input 4 (negative)
6	OPT_OUT2-	Output	Isolated output 2 (negative)
7	OPT_OUT4-	Output	Isolated output 4 (negative)
8	+5V_OUT	Output	+5 V/0.8 A power supply output
9	PGND	–	External power supply ground
10	GND	–	Signal ground
11	DIN_B-	Input	High-speed differential input 2 (reverse phase)
12	OPT_IN1-	Input	Isolated input 1 (negative)
13	OPT_IN2+	Input	Isolated input 2 (positive)
14	OPT_IN3+	Input	Isolated input 3 (positive)
15	OPT_IN4+	Input	Isolated input 4 (positive)
16	OPT_OUT2+	Output	Isolated output 2 (positive)
17	OPT_OUT4+	Output	Isolated output 4 (positive)
18	PGND	–	External power supply ground
19	DIN_A-	Input	High-speed differential input 1 (reversed phase)
20	DIN_A+	Input	High-speed differential input 1 (normal phase)
21	OPT_IN2-	Input	Isolated input 2 (negative)
22	OPT_OUT1-	Output	Isolated output 1 (negative)
23	OPT_OUT1+	Output	Isolated input 1 (positive)
24	OPT_OUT3-	Output	Isolated output 3 (negative)
25	OPT_OUT3+	Output	Isolated output 3 (positive)
26	+12V_OUT	Output	+12 V/0.8 A power supply output
Casing	Shielding GND	Casing	Connected with PC casing



Please manually lock the auxiliary fixing screws of the D-Sub 26 plug, and do not use an electric screwdriver. Do not lock the screw too tight to avoid damaging the connector (the torque during locking should not exceed 0.15 Nm).



It is recommended to use the factory standard external trigger connection cable, which is twisted for 2 pairs of differential input signal cables, thus providing better anti-interference performance.

3.2 Wiring requirements

It is important to carry out reasonable grounding and wiring on the trigger interface of the frame grabber, which can ensure the optimal operation performance of the system and provide better electronic noise protection for the frame grabber at the same time.

Before grounding and wiring, make sure that the power supply to the frame grabber has been disconnected. Likewise, make sure that the power supply to the devices connected to the frame grabber (for example PLC, encoder) has been disconnected.



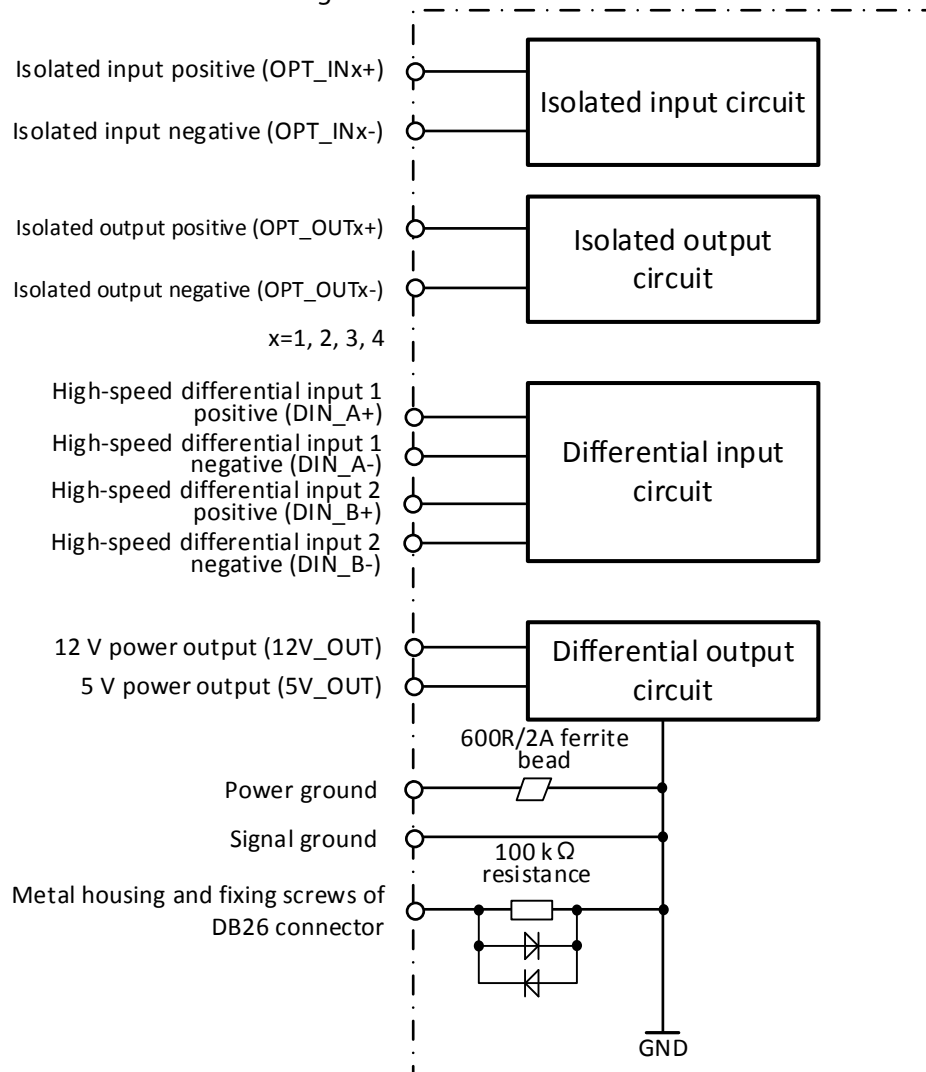
WARNING

- Installing or wiring the frame grabber and other device while power connected may result in electric shock or device damage. Follow appropriate safety precautions and make sure that the power to the frame grabber is disconnected.
- For specific applications, ensure that all grounding points for the frame grabber and other associated device are grounded at a single point, which should be connected directly to system ground. To improve resistance to electrical noise, we recommend that the common point of all DC power supplies be connected to the same single ground point, and the common point (M) of the sensor supply be grounded.
- All ground wires should be as short as possible and of a thicker gauge (not less than 2 mm² or 14 AWG).
- When selecting the grounding point, safety grounding requirements and proper protection of the isolation device should be considered.
- Avoid designing trigger signal lines, communication cables and AC lines or DC lines for high energy fast switching (for example, drive lines for relays, AC contactor coils) in the same raceway when routing. The best resistance to electronic noise characteristics is obtained by using shielded cables, and the best results are usually obtained by connecting the shield to the housing of the trigger interface.
- When the input circuit is powered from an external source, add overcurrent protection devices (for example, fuses) to the circuit.
- When using the frame grabber in scenarios with potentially strong interference sources (for example, motor drives, frequency converters), it is recommended to supply the frame grabber and the sensors it is connected to with a separate power supply, to avoid interference noise conducted on the power line.

3.3 Isolation instructions

To avoid unexpected currents flowing into the system, the frame grabber trigger interface is electrically isolated in suitable sections, and these isolations should be considered when designing the system. The following figure gives the state of insulation between the various terminal circuits of the trigger interface.

Figure 3-2 Isolation status



- There are 4 isolated input and output circuits in the same isolated circuit, and only one of them is shown in the figure.
- GND in the figure is the power ground of the frame grabber, which is also the power ground of the motherboard.
- The maximum withstand voltage between isolated signals and other external non-isolated interfaces (signals) is 100 VDC.



- Without special instructions, the metal shell of the panel trigger interface, the signal ground of the trigger interface, the power ground and the metal baffle of the frame grabber are not insulated. Please be careful not to generate potential difference between internal common terminals due to the positive grounding environment or the potential difference between devices, otherwise it will lead to the failure of peripheral devices or hosts such as connected computers.
- The optocoupler isolation of the frame grabber cannot be used as safety isolation.
- All low-voltage circuits connected with the frame grabber, such as sensor power supply, must be safely isolated from AC lines and other high voltages to meet various safety standards.
- If not otherwise specified, the metal case of the panel trigger interface, the signal ground and the power ground of the trigger interface, and the metal baffle of the frame grabber are not insulated. Be careful not to create a potential difference between the internal common terminals due to the potential difference between the positive grounding environment or devices, as this may result in malfunctioning of peripheral devices such as the connected computer or the host computer.

- The optocoupler isolation of the frame grabber cannot be used as a safety isolation.
- All low-voltage circuits connected to the frame grabber, such as the sensor power supply, must have safe isolation from AC lines and other high voltage lines in compliance with various safety standards.



WARNING

- Supplying power to devices from power supply used in AC circuits that are not isolated will generate unsafe voltage in safety circuits (such as sensor circuits and communication circuits). This high voltage can result in death or serious personal injury or device damage.
- Use an inverter to convert high voltage to low voltage, to ensure the safety of the circuits.

3.4 Instructions



- The frame grabber is a static sensitive device. Before removing the frame grabber, touch your hand with a metal grounded object (for example, grounded PC host chassis) to discharge static electricity. When you take out the frame grabber, you can temporarily place the frame grabber on an anti-static bag, and do not contact the frame grabber with felt, silk and other fabrics that are prone to static electricity.
- Before installing the frame grabber, you need to power off the host, unplug the host AC power input, and wait for the motherboard to finish discharging. Generally wait 1–2 minutes to complete the discharge. For the motherboard with power indicator, you need to wait for the power indicator on the motherboard to turn off before operation.
- When inserting the frame grabber, hold the bending position of the frame grabber's baffle in one hand, and hold its upper edge (the position above the on-board trigger interface) in the other hand. Insert the grabber vertically from top to bottom, and check whether the back plate of the frame grabber is reliably lapped with the EMC shrapnel of the chassis. After inserting the grabber into the chassis, use the screws to fix the back plate. During operation, do not shave the frame grabber from side to side, and avoid bumping between the frame grabber and the internal components of the host computer. Do not use your fingers to touch the lower edge of the frame grabber and the motherboard contact gold finger parts, to avoid contaminating the contact surface, resulting in poor contact.
- The frame grabber is designed to take the natural convection heat dissipation method. You need to leave enough space around the frame grabber for normal heat dissipation. For example, if the motherboard has more than one available PCIe slot, it is recommended that you separate the frame grabber and other boards with one slot during installation.
- When placing the host chassis, reserve enough space on the back plate area of the frame grabber for the cable, and reserve enough bending radius for the cable. If the bend radius is too narrow, it will put extra force on interfaces of the frame grabber and damage the interfaces.



If the frame grabber is in a high vibration environment, additional reinforcement is required on the cable interface.

3.5 Trigger interface overview

The frame grabber has 2 trigger interfaces: panel trigger interface and on-board trigger interface.



Some models have no trigger interface. Refer to the actual product.

The panel trigger interface provides a DB26 connector, which allows you to connect the trigger cable directly to the external signal source, or use an adapter cable to connect to the external trigger signal distribution board (optional), and then connect the corresponding signal to the signal distribution board.

The on-board trigger interface is used to expand the I/O signals and provide additional trigger inputs for 4-port SDR Cameralink frame grabber applications. You can use the on-board trigger interface to

expand card (optional) of the on-board, to transfer the on-board trigger interface signals to the PC's rear panel.

Each trigger interface includes 4 isolated inputs, 4 isolated outputs, 2 high-speed differential inputs, 12 V/0.8 A power output, and 5 V/0.8 A power output. Except for different interface signal pin definitions, the corresponding interfaces of the 2 trigger interfaces have the same circuit implementation.

Input interface:

1. Isolated input, opto-coupler isolated unidirectional input for connecting single-ended encoder, photoelectric sensor and PLC output.
2. High-speed differential input, specially used for connecting differential encoder output.

Output interface:

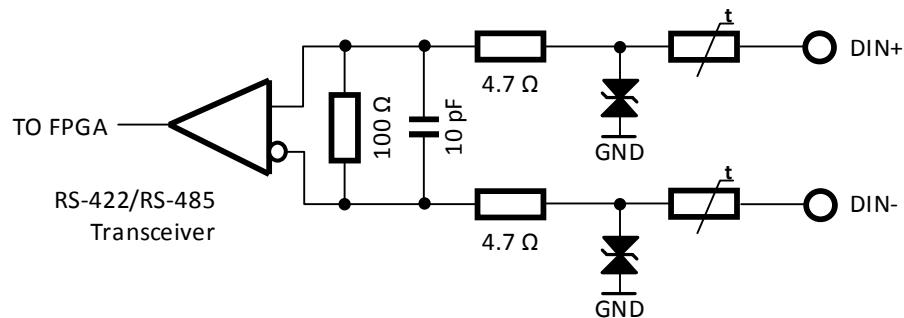
Isolated output, optocoupler-isolated NPN output, used for controlling light source triggering, PLC input.



- Optocoupler isolation input can provide better common-mode noise suppression.
- Keep electrical isolation between all isolation interfaces, and keep electrical isolation between different isolation interfaces of the same type.
- The functions of all interfaces are fixed, and there is no patch cord or switch on the hardware for operation.

3.6 High-speed differential input

Figure 3-3 High-speed differential input



The high-speed differential input interface has the following features:

- Non-isolated RS422 differential line transceiver.
- ± 24 V common-mode voltage input range.
- 15 kV HBM static protection capability.
- Pulse input with a minimum width of 50 ns.
- Up to 10 MHz pulse input.
- Built-in 100 Ω terminal connection resistance.
- Ensure the high input status (Bus Fail-Safe function) when the external connection is not connected.
- Built-in analog and digital high frequency noise filter circuit.

The following table describes the input level and input status of the differential interface.

Table 3-2 Input voltage and logic status of high-speed differential interface2

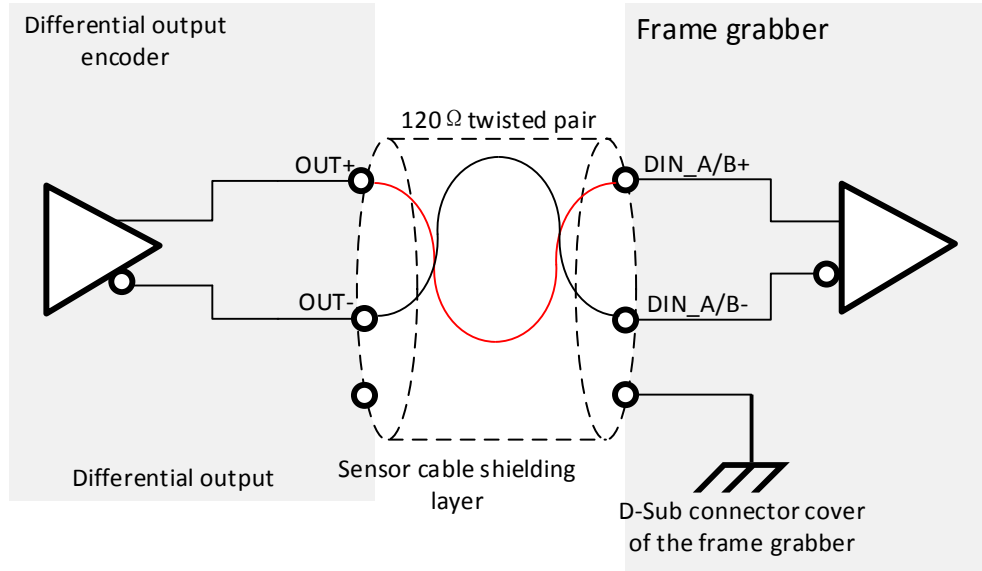
Input voltage	Input status
$(V_{DIN+} - V_{DIN-}) > V_{threshold}$	High (logical 1)
$(V_{DIN+} - V_{DIN-}) < -V_{threshold}$	Low (logical 0)
Input not connected	High (logical 1)



- For input signals below 1 MHz, $V_{threshold} = 200$ mV. For input signals below 5 MHz and above 1 MHz, $V_{threshold} = 500$ mV. For input signals above 5 MHz, $V_{threshold} = 800$ mV.

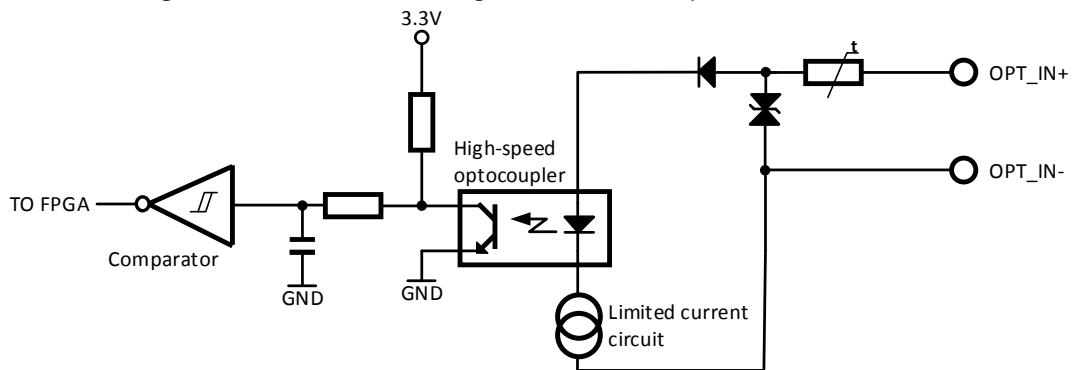
- The high-speed differential interface uses the signal ground as the common-mode voltage reference ground. Connect the power source output by the differential encoder to this pin.
- ⚠
- Do not connect a single-terminal signal to a differential input interface, which will damage the internal interface circuit. Use the isolated input channel to connect the single-terminal signal.
- Use the high-speed differential interface to connect the differential encoder.

Figure 3-4 Use high-speed differential interface to connect differential encoder



3.7 Isolated input

Figure 3-5 Internal circuit diagram of isolated input interface1



The isolated input interface has the following features:

- Fixed input current threshold is about 3 mA, not adjustable.
- Fixed input voltage threshold is about 2 V, adjustable by means of an external series resistor.
- Maximum low level input voltage is about 1.4 V (within nominal operating temperature range).
- Minimum high level input voltage is about 2.2 V (within nominal operating temperature range).
- Input current limit: maximum input current 9 mA (26 V input voltage).
- Forward and reverse maximum input voltage not exceeds 26 V.
- Each input is individually isolated.
- The electrical withstand voltage value between isolated inputs and non-isolated terminals is 500 VAC RMS/1 minute.
- When the input amplitude is 2.2 V (minimum high level value), the minimum input pulse width is 5 μ s.
- Maximum input frequency: the maximum input signal frequency is 100 KHz.
- When not connected, the input state is low (logic 0).



Unless otherwise specified, the above values are only typical values measured at the ambient temperature of 25 °C. There are differences between different frame grabbers, and there are also differences under different working temperatures.



Although the isolation input circuit itself is designed according to the electrical withstand voltage value of 500 VAC RMS/1 minute, considering the limitation of the highest withstand voltage value at the external cable end, please use it in scenarios not higher than 100 VDC.

Table 3-3 Isolation input voltage and status3

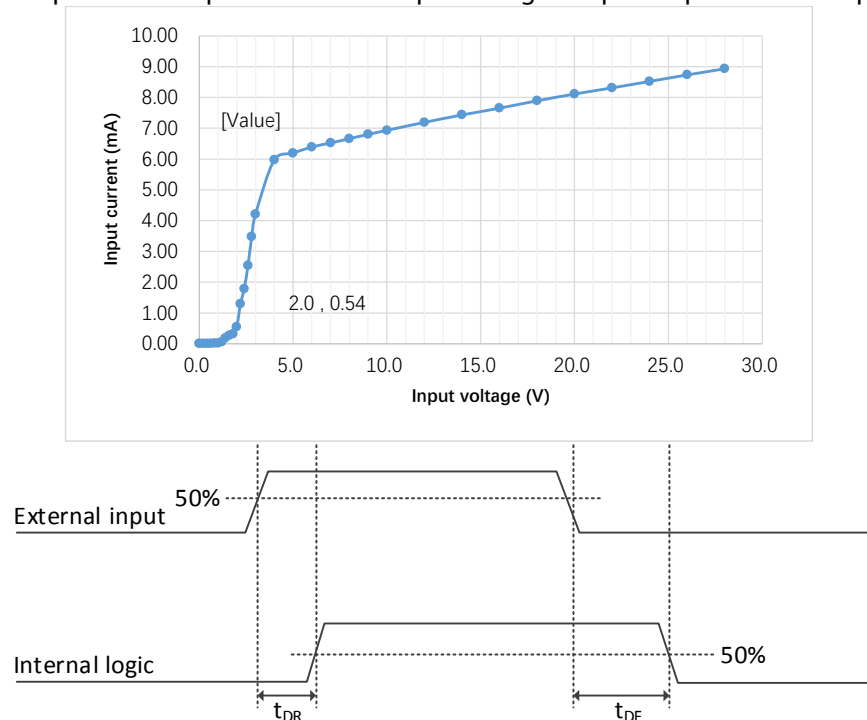
Input voltage	Description
+26VDC	Limit voltage input, which must be not exceeded. otherwise, the device may be damaged.
+0 to +24VDC	Safe operating voltage input range
+0 to +1.4VDC	Indicates logic 0 (low).
>+1.4V to +2.2VDC	The input status changes within this range, within which the logic status is unsteady
>+2.2VDC	Indicates logic 1 (high).
Not connected	Indicates logic 0 (low).



The input voltage is the potential difference between the positive OPT_IN + and the negative OPT_IN-of the isolated input.

The relationship between input current and input voltage of isolation input port is shown in the following figure.

Figure 3-5 Relationship between input current and input voltage of optocoupler isolated input port4



The relationship between the amplitude of different input signals and trigger delay is as follows.

Table 3-4 Relationship between input signal amplitude and trigger delay5

Input Signal Amplitude (Vp-p)	Rising Edge Trigger Delay t _{DR} (us)	Falling Edge Trigger Delay t _{DF} (us)
3	1.8483	1.6776
5	1.6562	1.6785
10	1.7040	1.6859
20	1.5757	1.6840



- The above values are typical values measured at the ambient temperature of 25°C, and there are individual differences between different frame grabbers, and there are also differences under different working temperatures.
- Trigger delay measures the delay from the external isolation signal input port OPT_IN to the FPGA input pin, without considering the internal logic delay of the FPGA.
- The trigger delay measurement is based on the delay time from 50% of the external input signal amplitude to 50% of the FPGA pin input signal amplitude.



- Do not apply voltage exceeding the rated voltage at the input terminal.
- You cannot change the interface fuse. After the fuse is broken due to abnormal conditions such as overvoltage, please contact the manufacturer for after-sales maintenance.



- Isolation input channels 1 and 2 support high frequency signal input. It is recommended to use encoders that connect single-terminal output (including NPN, PNP, and mutual compensation) to provide line trigger signals of linear array frame grabbers.
- Isolation input channels 3 and 4 only support signal input at low frequency, and have strong high frequency interference suppression capability. It is to be used to connect switching value output sensors (such as photoelectric sensors) to provide frame trigger signals of the frame grabber.
- In order to improve the noise suppression capability of the isolation input port, it is recommended to connect the resistance in series in the input circuit. The typical value of 12V power supply is 4.7kΩ, and the typical value of 24V is 10kΩ.

The wiring diagram of the isolated input interface connecting to the NPN output sensor is as follows:

Figure 3-6 Wiring diagram of connecting NPN output sensor2

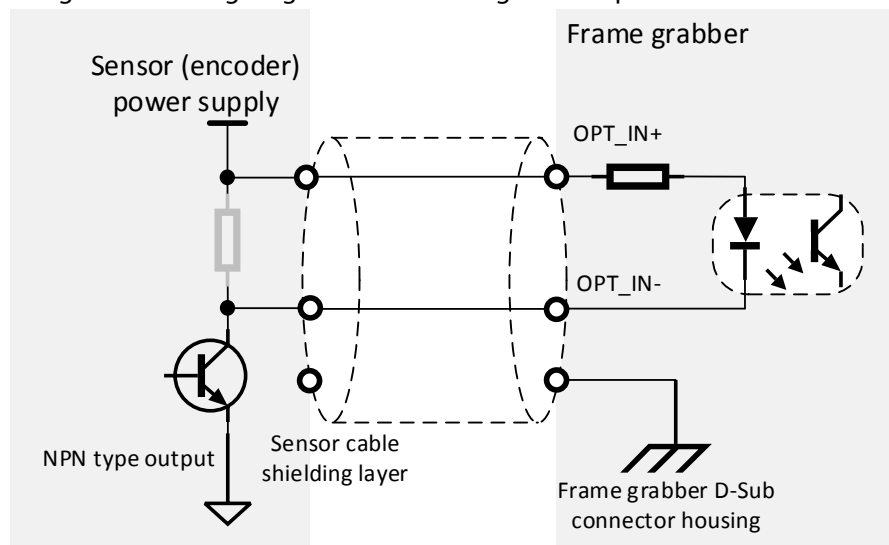


Figure 3-7 Wiring diagram of connecting PNP output sensor

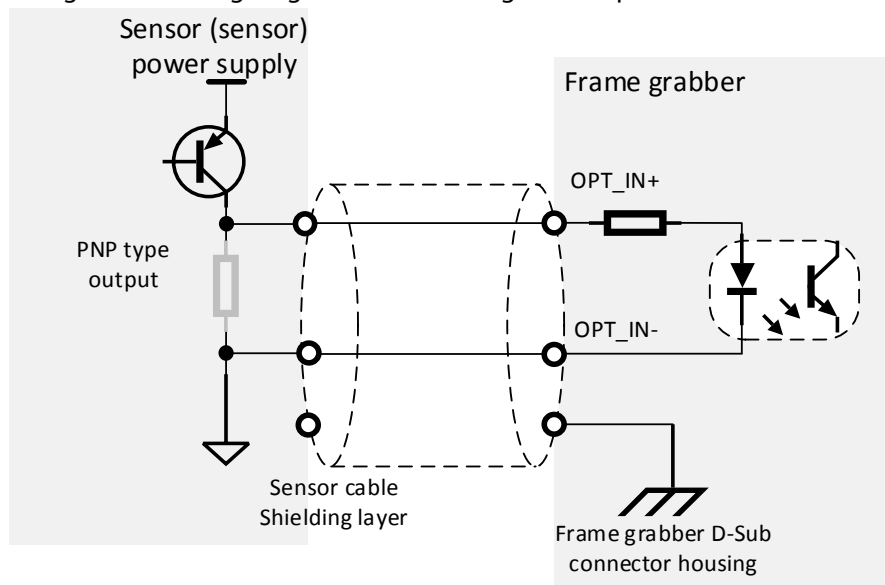


Figure 3-8 Wiring diagram of connecting the complementary output sensor

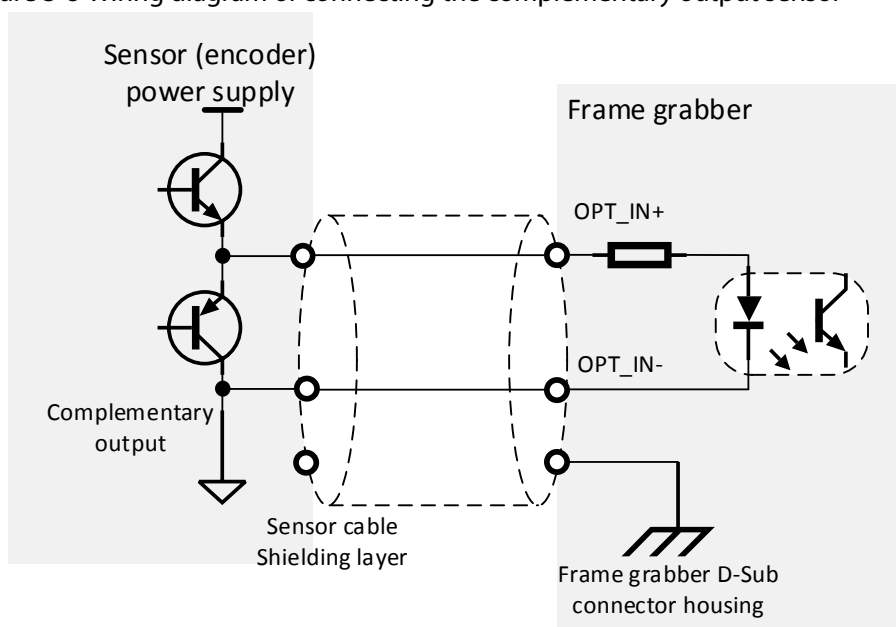
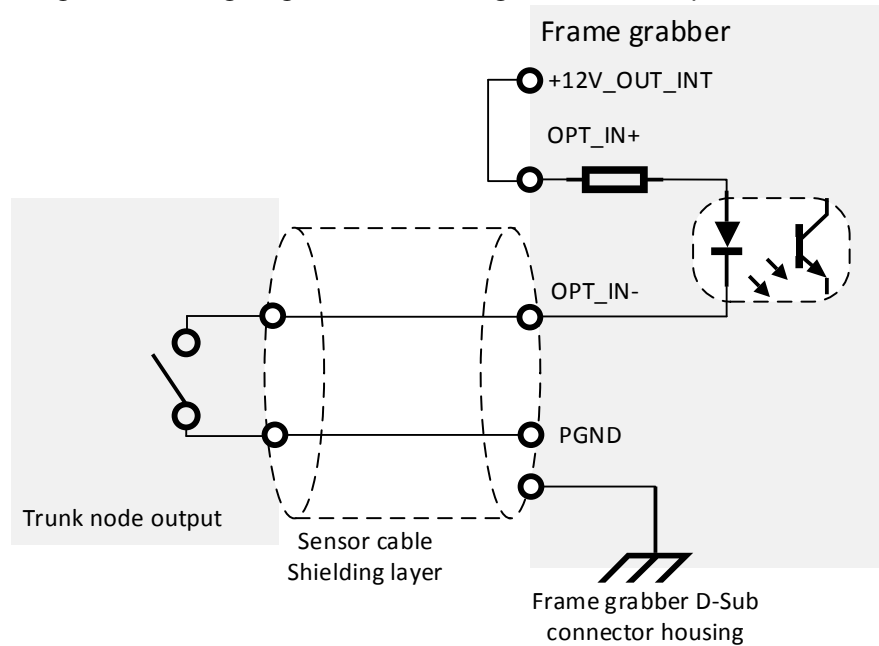
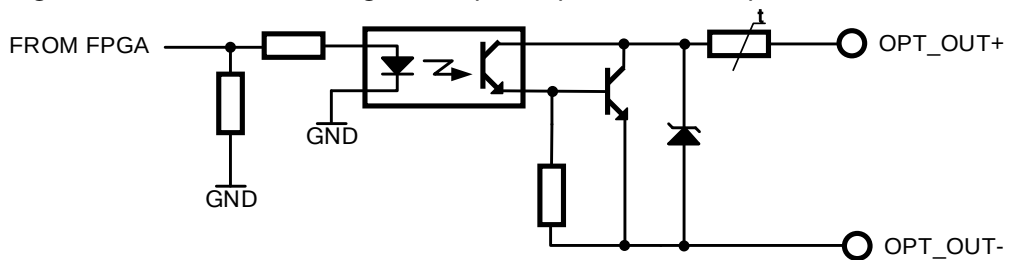


Figure 3-9 Wiring diagram of connecting trunk node output



3.8 Isolated output

Figure 3-10 Internal circuit diagram of optocoupler isolated output interface



The isolated output interface has the following features:

- Optocoupler isolated outputs.
- Polarized outputs (not reversible).
- Electrically isolated.
- Each input is individually isolated.
- Electrical withstand voltage value between isolated inputs and non-isolated terminals is 500 VAC RMS/1 minute.
- Maximum output current is 100 mA.
- Maximum open circuit operating voltage is 30 V.
- Maximum closed circuit voltage³ is about 0.7 V when measured at 100 mA load current), or about 0.4 V when measured at 1 mA load current.
- Switching speed: turn-on time is less than 5 μ s, and turn-off time is less than 20 μ s.
- Maximum operating frequency is 50 KHz.
- Remains open (off) when not initialized.



Although the isolated output circuit itself is designed according to the electrical withstand voltage value of 500 VAC RMS/1 minute, considering the limitation of the highest withstand voltage value at the external cable end, please use it in scenarios not higher than 100 VDC.

Table 3-5 Description of isolated output voltage range⁶

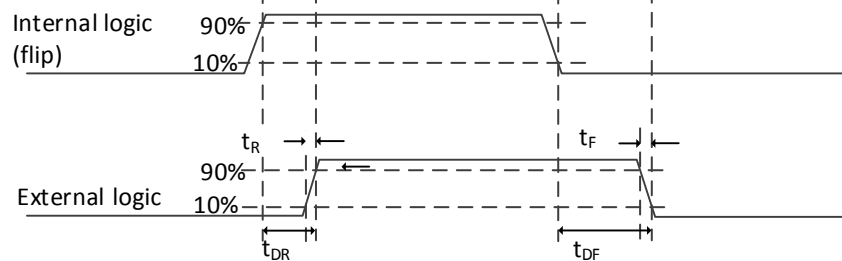
Voltage	Description
+26 VDC	Limit voltage, the input must not exceed this limit value, otherwise the device will be damaged.
<+3.3 VDC	I/O output may be incorrect.

+3.3 to +24 VDC	Safe operating range of I/O outputs.
-----------------	--------------------------------------

Table 3-6 Output state and interface circuit state7

Input status	Isolated output port
High (logical 1)	Output switch closed (ON)
Low (logical 0)	Output switch disconnected (OFF)
Initial status after power-on	Output switch disconnected (OFF)

Figure 3-11 Diagram of isolated output signal delay



3

When using 1 k Ω pull-up resistor, measure the rising/falling time and rising/falling edge delay time of the output waveform under different external power supply voltages as follows:

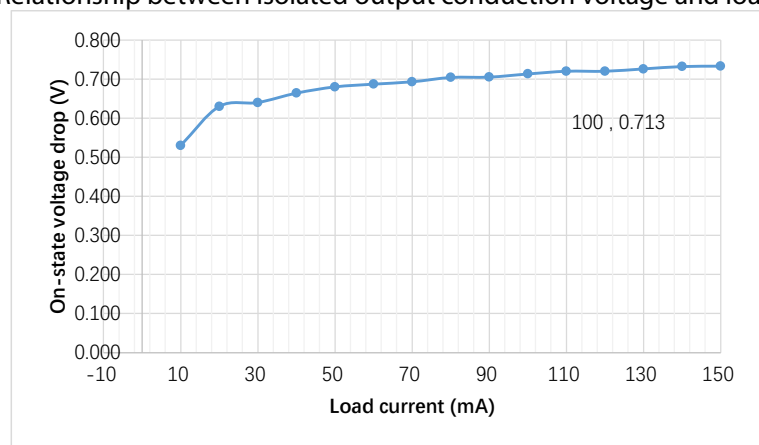
Table 3-7 relationship between output signal delay and external power supply voltage8

Preset power supply voltage (V)	Enable time (us)	Enable delay (us)	Shutdown Time (us)	Shutdown delay (us)
3	1.2848	2.2467	17.013	2.2467
5	1.5375	2.3429	15.745	25.197
10	1.7975	2.5262	15.316	30.319
20	2.4407	2.8179	22.338	37.122



- The output delay refers to the delay from the internal logic output of the FPGA to the external optoisolator output pin LINE0, without taking into account the internal logic delay of FPGA.
- Rising time refers to the time when the output pulse rises from 10% to 90%, and falling time refers to the time when the output pulse rises from 90% to 10%. The rising edge trigger delay refers to the time from 10% of the internal logic to 90% of the output pulse, and the falling edge trigger delay refers to the time from 90% of the internal logic to 10% of the output pulse.
- The above values are typical values measured at the ambient temperature of 25 °C, and there are individual differences between different frame grabbers.

Figure 3-12 Relationship between isolated output conduction voltage and load current



- The voltage drop is the voltage difference between OPT_OUT (LINE0) and OPT_GND when the optocoupler is connected.
- The above curve is the typical value measured at the ambient temperature of 25 °C, and there are individual differences between different frame grabbers.



- The pull-up resistance value shall not be greater than the maximum allowable current value at the optoisolator output port under the given voltage. The larger the pull-up resistance is, the lower the optocoupler voltage drop will be, the longer the rise and fall time of the output waveform will be, and the lower the external driving capability will be.
- The recommended resistance for the optocoupler is 1 k Ω at 3.3 V, 1 k Ω at 5 V, 2.4 k Ω at 12 V, and 4.7 k Ω at 24 V.
- The isolated output port is separated from the internal circuit through the optocoupler isolator, so the transistor output can be used as NPN output or PNP output.

Figure 3-13 Isolated output interface as NPN output

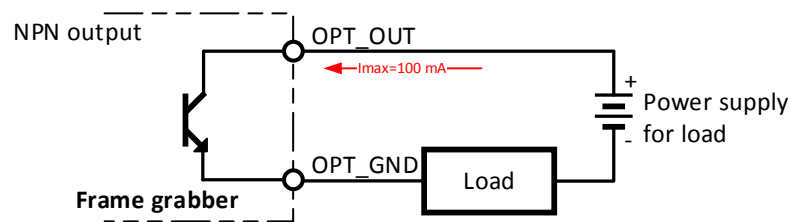
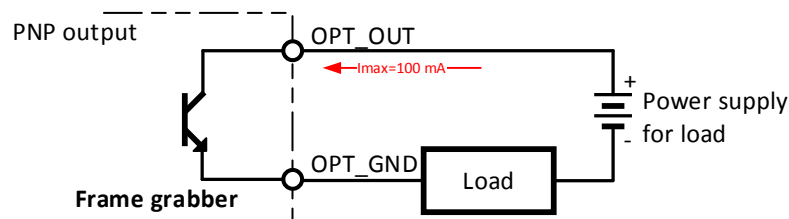


Figure 3-14 Isolated output interface as PNP output

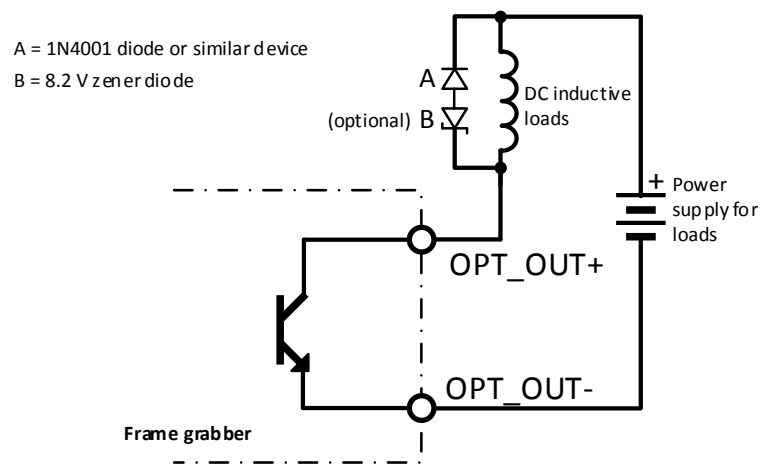


4



- The optocoupler isolated output port allows a maximum of 100 A of current to pass continuously. Do not apply voltages or loads to the output terminals that exceed the maximum switching capacity.
- You cannot replace the interface fuse. If the fuse is blown due to overcurrent such as short circuit, contact after-sales service.
- Using the frame grabber outputs to drive inductive loads (for example, relays) must be done with relay models that have built-in continuity diodes, or with externally added continuity diodes; otherwise, overvoltage damage to the output interface will result. The following figure gives an example of a suppression circuit for a DC inductive load. In most applications, it is sufficient to use additional diode A. However, if the application requires faster turn-off, we recommend adding regulator diode B. Ensure that the regulator diode is capable of meeting the current requirements of the output circuit.
- When using isolated outputs to connect tungsten lamp loads, avoid using isolated outputs for direct connection, because the inrush current of the tungsten lamp at the moment of turning on is 10 to 15 times its steady state current, which exceeds the maximum current of the isolated outputs. We recommend using a replaceable plug-in intermediate relay or incorporate an inrush limiter.

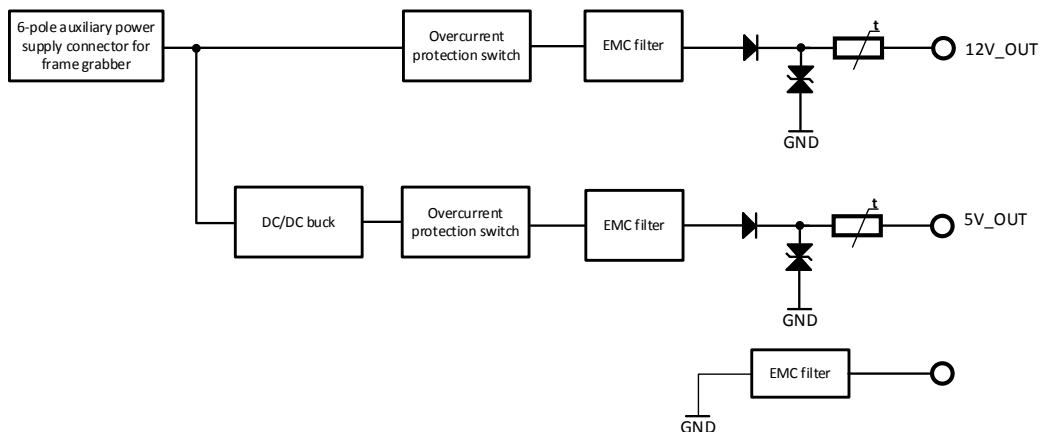
Figure 3-15 Suppression circuit for DC inductive loads



3.9 Power output5

The frame grabber trigger interface comes with 2 power outputs to provide power for external sensors (such as encoders and photoelectric switches).

Figure 3-16 Internal function block diagram of power output interface6



The power supply output interface comes from the 6-core auxiliary power supply interface of the frame grabber. For the use of this function, the PCIe auxiliary power supply interface of ATX power supply must be connected to the 6-core auxiliary power supply interface of the frame grabber.

The power output interface is built-in with an electronic switch with overcurrent protection function. The overcurrent trigger point is 0.96 A. When an abnormal situation such as overcurrent (short circuit) occurs in the external load, the circuit automatically cuts off the external power supply, and automatically recovers after the fault is eliminated.

The nominal values of the power output are +5 V/0.8 A and +12 V/0.8 A respectively. The power output switch can be configured through software.



- +5 V power output can supply power to differential (linear) output incremental encoders (such as E6B2 series).
- +12 V power output can supply power to incremental encoders (such as E6B2 series) output of single-end (NPN, PNP, and mutual supplement).



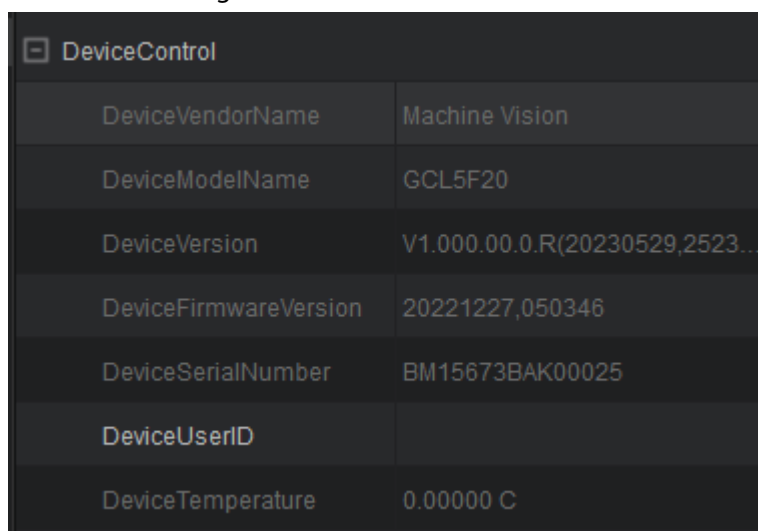
If the power output of the frame grabber is used, turn off the power output before wiring.

4 Frame grabber function parameters

The frame grabber properties in the MV Viewer software are for basic configuration and parameter debugging, mainly including device control, basic timing, internal trigger control, external trigger control, method control, output trigger control, ISP control, statistics control, and user set control.

4.1 Device control

Figure 4-1 Device control module



DeviceControl	
DeviceVendorName	Machine Vision
DeviceModelName	GCL5F20
DeviceVersion	V1.000.00.0.R(20230529,2523...
DeviceFirmwareVersion	20221227_050346
DeviceSerialNumber	BM15673BAK00025
DeviceUserID	
DeviceTemperature	0.00000 C

Table 4-1 Description of control modules

Parameter	Description
DeviceModelName	Frame grabber name.
DeviceVersion	Frame grabber version information.
DeviceFirmwareVersion	Frame grabber firmware version.
DeviceSerialNumber	Frame grabber serial number.
DeviceUserID	Frame grabber user ID (defined according to actual project requirements).

4.2 Basic timing

The basic timing module includes the basic parameter settings of the frame grabber. It includes **DeviceScanType**, **ColorType**, **PixelFormat**, **Width**, **Height**, **DeviceTapGeometry**, **PoCL** and **TestImageSelector** must ensure the consistency with the current connected camera when setting the module parameters.

Figure 4-2 Basic timing

BasicTiming	
DeviceScanType	Linescan
ColorType	Monochrome
PixelFormat	Mono8
Width	5,120
Height	2,048
Field	1
DeviceTapGeometry	Geometry_1X8
PoCL	Enable
PowerOut	Off
TestImageSelector	TestImage1

DeviceScanType

This parameter is the scanning type of the camera currently connected to the frame grabber, which is categorized into 2 types: **Areascan** and **Linescan**.

- When the frame grabber is connected to an area scan camera, select **Areascan** from the drop-down box.
- When the frame grabber is connected to a line scan camera, select **Linescan** from the drop-down box.

ColorType

This parameter is the color type of the captured image, which is divided into **Monochrome** and **Color**. Before using the frame grabber to capture images, make sure that the image type of the frame grabber is the same as the output image type of the camera. When the camera output image type is black and white, select **Monochrome** for the frame grabber image color type, and when the camera output image type is color, select **Color** for the frame grabber image color type.

PixelFormat

This parameter is the frame grabber image data format, which indicates the pixel depth of each pixel color channel. When the image color type is **Monochrome**, the value of the image data format is the same as the pixel depth value, and the currently supported image data formats are Mono8, Mono10, Mono12, and when the image color type is **Color**, the value of the image data format is the same as the pixel depth value of each color channel, and the currently supported image data formats are BayerGR8, BayerGR10, BayerGR12, BayerRGB8, BayerRGB8, BayerRGB8, and BayerRGB12. When the image color type is **Color**, the image data format value and the pixel depth value of each color channel are the same, and the currently supported image data formats are BayerGR8, BayerGR10, BayerGR12, BayerRGB8, BayerRG10, BayerRG12, BayerGB8, BayerGB10, BayerGB8, BayerGB10.

Before using the frame grabber to capture images, you need to select an image type that is consistent with the camera's output image type, which can be obtained by switching to the camera's properties or checking the corresponding camera's product manual.

Width

This parameter is the width of the captured image, that is, the number of pixels in the horizontal direction. You can click camera properties to get the width of the image output from the currently connected camera, or check the product manual of the corresponding camera to get it. The value of

width should not be larger than the maximum width of the output image from the camera, or else it will lead to image acquisition failure.

Height

This parameter is the height of the captured image, i.e. the number of image rows. You can click the camera properties to get the number of image rows output by the currently connected camera, or check the product manual of the corresponding camera to get the value of height, which should not be greater than the maximum height of the output image of the camera, or else it will lead to image acquisition failure.

TestImageSelector

This property is the test image type, which include 3 choices:

- 1: off.
- TestImage1 (static image).
- TestImage2 (dynamic image).

Power Out

The trigger interface of the frame grabber comes with 2-way power output, which is used to provide power for external sensors (for example encoder, photoelectric switch). By setting the parameter **PowerOut**, configure the IO port for external output, Pow_12V corresponds to the IO port +12V_OUT, Pow_5V corresponds to the IO port +5V_OUT, and **ALL** indicates that +12V_OUT and +5V_OUT are output at the same time.



When using the **PowerOut** function, the frame grabber must be connected with ATX 6-core auxiliary power supply.

Table 4-2 Basic parameter list

Parameter	Description
DeviceScanType	Device scan type
ColorType	Color setting
PixelFormat	Image data format
Width	Image width
Height	Image height
DeviceTapGeometry	Channel mode
PoCL	PoCL power supply
Power Out	External Power Supply
TestImageSelector	Test chart

Testimage (Test Mode)

The frame grabber has the function of setting the test mode. When the frame grabber turns on the test mode, the image output by the frame grabber is not the real-time image, but the image generated internally by the frame grabber program. When the real-time image is abnormal, you can roughly determine the cause of the image abnormality by checking whether the image in test mode has similar problems. This function is not enabled by default, at this time the image output from the camera is the real-time captured data.

- The test mode is set through the **TestImageSelector** parameter under the **BasicTiming** parameter, and the frame grabber defaults the test image to **Off**, that is, the test image is not turned on.
- After the test mode is turned on, the image displayed in the live view window of the frame grabber software is switched to the test image, and the specific test image is determined by the test mode.

Figure 4-3 Test mode

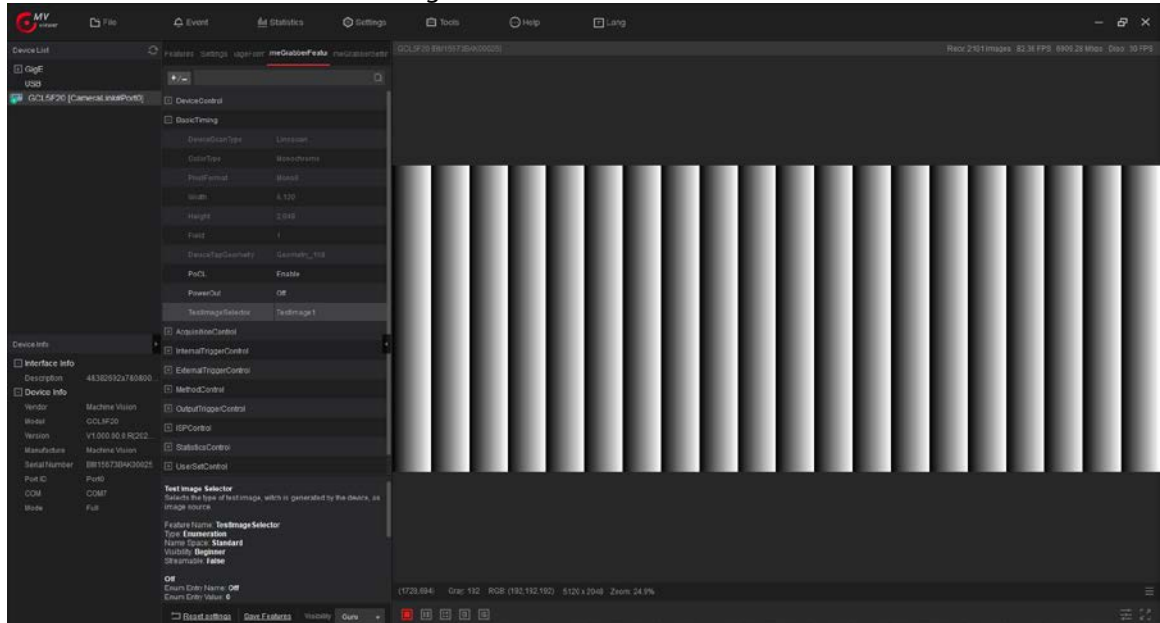


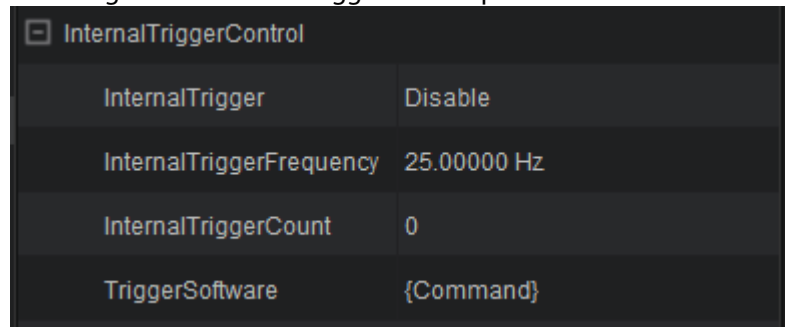
Figure 4-4 Effect



4.3 Internal trigger control

The InternalTriggerControl module is the internal trigger control of the frame grabber, and it includes InternalTrigger, InternalTriggerFrequency, InternalTriggerCount, and TriggerSoftware. Its main function is to simulate and generate signals internally for the frame grabber.

Figure 4-5 Internal trigger control parameters



InternalTrigger

This parameter is the internal trigger switch of the frame grabber. When this function is used, select **Enable** mode from the drop-down list.

InternalTriggerFrequency

This parameter is the signal trigger frequency inside the frame grabber. The frequency range that can be set is 1 Hz–500 kHz, and the precision is 0.1 Hz. Because the signal frequency of digital synthesis is scattered data, the software will pre-process and correct the internal trigger signal frequency set by the user. The frequency value seen in the edit box is the actual output frequency after the pre-processing correction is completed.

InternalTriggerCount

This parameter is the number of triggers internally in the frame grabber. The number of times can be set to 0–4294967295 (0 indicates continuous signal generation).

TriggerSoftware

This parameter is soft trigger of the frame grabber, which generates a signal at a time.



When **TriggerSoftware** is executed, **InternalTrigger** must be turned off.

Table 4-3 Internal trigger control parameters

Parameter	Description
InternalTrigger	Internal trigger switch
InternalTriggerFrequency	Internal trigger frequency
InternalTriggerCount	The number of internal triggers
TriggerSoftware	Soft trigger

4.4 External trigger control

Figure 4-6 External trigger control parameters

ExternalTriggerSource	ExternalTrigger1
ExternalTriggerActivation	RisingEdge
ExternalTriggerDebounceTime	1.00000 us
ShaftEncoderSource	DifferentialInput
ShaftEncoderDirection	Reverse
ShaftEncoderDebounceTime	1.00000 us
ShaftEncoderChannel	ChannelA
ShaftEncoderMultiplyFactor	1
ShaftEncoderDivisionFactor	1
ShaftEncoderDelay	1.00000 us
ShaftEncoderCompensation	Off
ShaftEncoderMaximumSpeed	1,000
BoardSyncMode	Slave

Table 4-4 External trigger control parameters

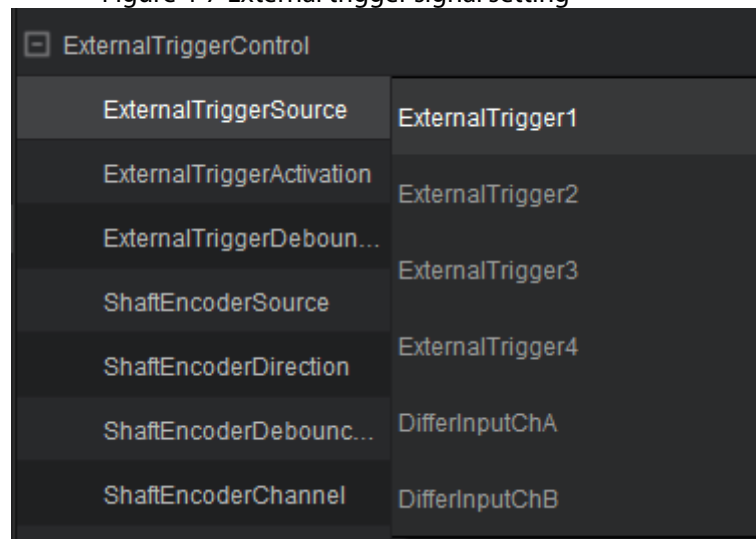
Parameter	Description
ExternalTriggerSource	4 external trigger sources are provided: ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, and ExternalTrigger4.
ExternalTriggerActivation	External trigger mode: RisingEdge (rise edge trigger), FallingEdge (fall edge trigger), AnyEdge (rise or fall edge trigger), and Bypass (permeable transmission). Bypass: This mode does not process the signal and transmits it as is.
ExternalTriggerDebounceTime	External trigger filtering settings [0 μ s, 1000000 μ s], adjusted according to the actual situation.
ShaftEncoderSource	Rotation encoder source: differential encoder and single-end encoder.
ShaftEncoderDirection	Rotate the direction of the encoder: forward, reverse, both (forward and reverse), bypass.

ShaftEncoderDebounceTime	The filtering setting of the rotary encoder [0 μ s, 1000000 μ s] is adjusted according to the actual situation.
ShaftEncoderChannel	Encoder signal: channelA, channelB, channelAB.
ShaftEncoderMultiplyFactor	Encoder frequency dual setting [1, 8191].
ShaftEncoderDivisionFactor	Encoder frequency division settings [1, 8191].
ShaftEncoderDelay	Pulse delay [0 μ s, 100000000 μ s].
ShaftEncoderCompensation	Reverse count switch.
ShaftEncoderMaximumCompensation	Limit on reverse count [0, 4294967295].
BoardSyncMode	Synchronization mode: main and sub.

4.4.1 External trigger signal input

The frame grabber can receive multiple external input signals. A total of 4 single-end input signals and 2 differential input signals are transmitted through the **ExternalTriggerSource**. ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, and ExternalTrigger4 correspond to 4 isolated input signals respectively, for example, the corresponding I/O interfaces of ExternalTrigger1 are OPT_IN1 + and OPT_IN1-, and so on. DifferInputChA and DifferInputCh correspond to 2 differential input signals, for example, the corresponding I/O interfaces of DifferInputChA are DIN_A+ and DIN_A-.

Figure 4-7 External trigger signal setting



- Step 1** Select **ExternalTriggerSource** to set the signal source.
- Step 2** Select **External Trigger Activation** to set the trigger mode. You can set the rising edge trigger, falling edge trigger, rising or falling edge trigger, or directly pass the external input signal to the camera.
- Step 3** Select **ExternalTrigger Debouncer Time** to set the filter value. Generally, we recommend using the default parameter. When the external noise is too large, it can be appropriately increased.

4.4.2 Encoder

The encoder can convert the displacement of the roller into an electrical signal, and the frequency of the signal is proportionally related to the displacement speed, and the line scan camera can trigger the signal in a row. When the maximum running speed of the roller does not exceed the upper limit of the signal precision of the encoder, there is no abnormal stretching compression between the captured images and the actual situation.

- Step 1** Select **ShaftEncoderSource** to set the signal source, which is divided into differential encoder and single-terminal encoder. The I/O interfaces corresponding to the differential encoder are DIN_A + and DIN_A-, DIN_B + and DIN_B-. The I/O interfaces corresponding to the single-terminal encoder are OPT_IN1 + OPT_IN1- and OPT_IN2 + OPT_IN2-.
- Step 2** Select the input source of the rotary coding line, that is, ChannelA, ChannelB, and ChannelAB.

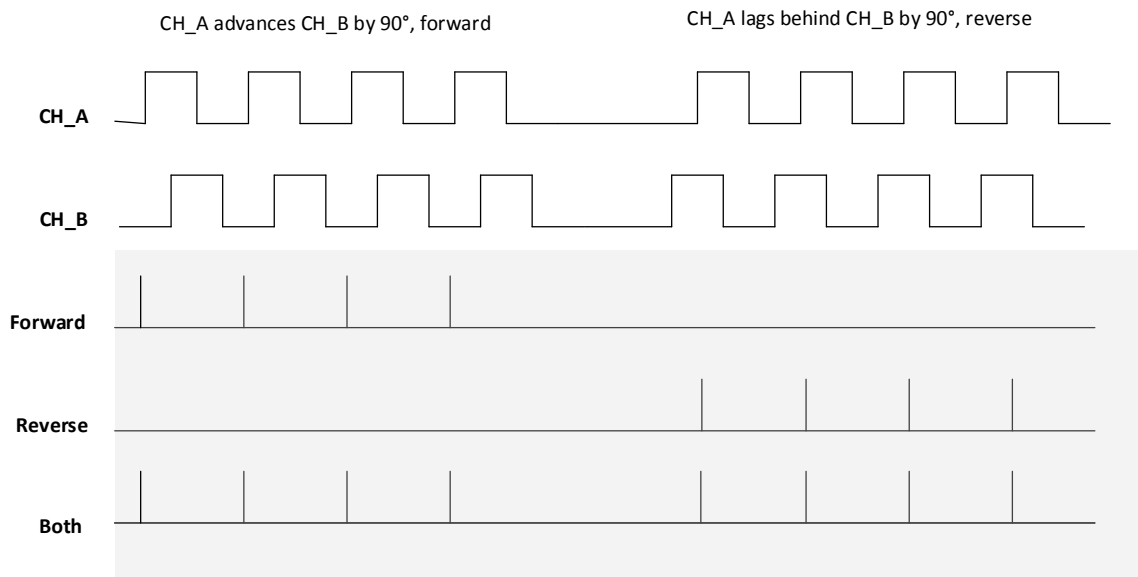


The input source wiring needs to be wired according to the actual frame grabber I/O electrical instructions.

If you select phase A or phase B as single phase, you can only judge whether the encoder is rotating or not. You cannot determine whether the encoder is rotating forward or reverse. You can set the ChannelAB double-phase signal to determine whether the platform is moving in the front and back directions.

- Step 3** Select **ShaftEncoderDirection** to determine the encoder direction. The trigger mode of rotation coding is divided into 4 modes: forward and reverse direction, two-way output and signal pass-through. When the platform trigger signal reaches the defined line height, a frame of graph is triggered.

Figure 4-8 Encoder trigger working mode



- Forward: when the encoder rotates forward, the image is displayed. When the encoder rotates reversely, the number of reverse signals is recorded. When the encoder rotates forward, the statistics of reverse count are reduced downward, and the image is displayed after it is reduced to 0, to avoid jittering.
- Both: in any direction, the encoder will show the image when it is in the forward and reverse directions. You need to set the frequency to 2.
- Reverse: the image is displayed when the encoder reverses.
- Bypass: directly transmits the external trigger signal to the camera, and the frame grabber does not process the signal.

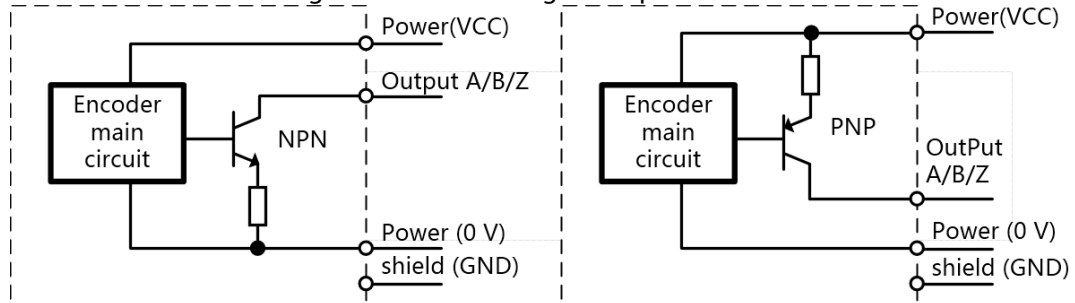
Advantages of encoder trigger:

- The output signal frequency of the encoder is proportional to the speed of the object, ensuring that the signal frequency is synchronized with the speed of the object's movement.
- The output pulse is used as the trigger signal of the line scan camera to synchronize the acquisition frequency of the camera with the movement speed of object.
- Images can be captured normally in the scene of non-uniform motion.
- When the object jitters in the environment, the image influence caused by jitter can be eliminated when it is a forward or reverse one-way output.

What is the difference between voltage output, collector signal output, and differential output of the encoder?

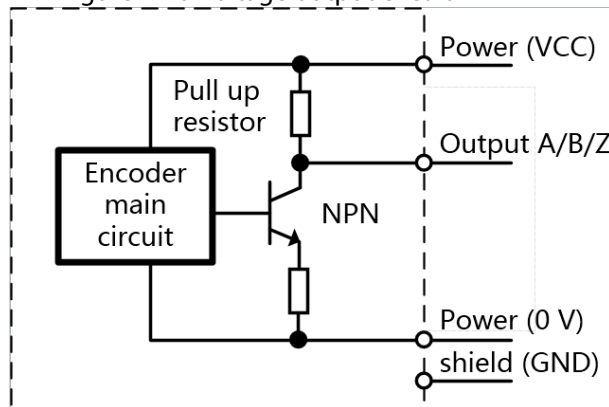
- Collector signal output is an output circuit with the emitter of the transistor of the output circuit as the common terminal and the collector suspended. It is generally divided into NPN and PNP open collector output.

Figure 4-9 Collector signal output



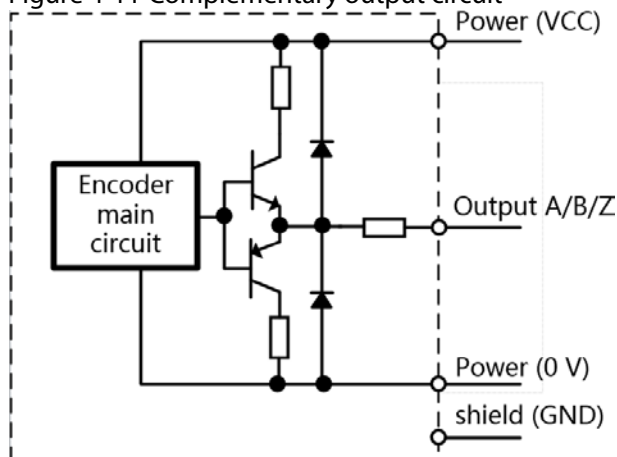
- The voltage output is based on the circuit of open collector output, and a pull-up resistor is connected between the power supply and the collector, so that there can be a stable voltage state between the collector and the power supply.

Figure 4-10 Voltage output circuit

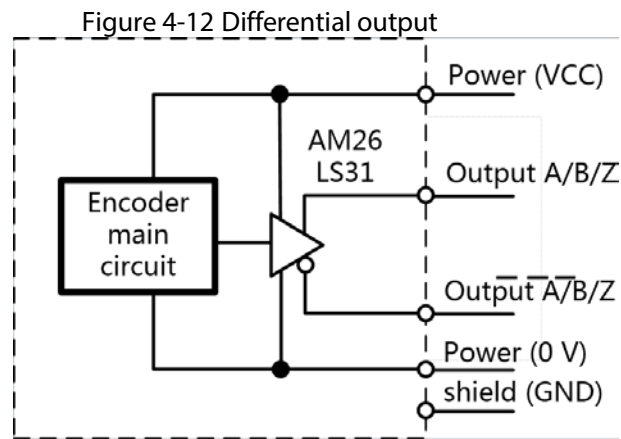


- The output circuit has 2 transistors, NPN and PNP, on the output at the complementary output. Depending on the level of the output signal, the 2 output transistors alternate switching action, which transmits over a slightly longer distance than a circuit with an open-collector output.

Figure 4-11 Complementary output circuit



- Differential output is a data transmission method based on the RS422-A specification with a dedicated IC output. The signals are output as 2 signals in a differential manner, making it highly resistant to interference, and suitable for long-distance, high-speed transmission. A dedicated IC called RS422 transceiver is used on the camera side to receive signals from the encoder.



What is the difference between an incremental encoder and an absolute encoder?

The incremental encoder does not record the angle of passing after power failure. The absolute encoder can save the previous passing angle after power failure, and can record up to 360°. Our line scan cameras only support incremental encoders.

What causes missing pulses of rotary encoder?

Possible causes include:

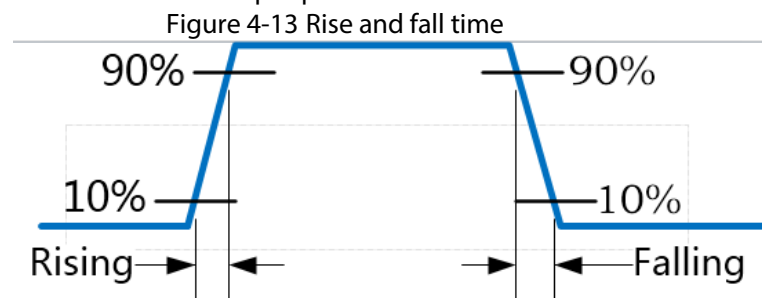
- The rotation speed is too fast, exceeding the response frequency of the encoder or subsequent device.
- Wire extension is too long, signal attenuation.
- Encoder hardware problems and device failures.
- There is jitter or interference in the field environment, including mechanical transmission device jitter and electrical cable interference.
- The encoder and the motor shaft are not fixed tightly and there is an eccentricity angle.

How to know the quality of a rotary encoder?

- Check whether the number of pulses is correct when connecting the camera.
- Connect the microphone to view the waveform.
- Use a multimeter to test whether the output is normal.
- ◇ When the encoder is NPN output: measure the positive pole of the power supply and the signal output line. When the transistor is ON, the output voltage is close to the encoder power supply voltage, and when the transistor is OFF, the output voltage is close to 0 V.
- ◇ When the encoder is PNP output: measure the negative pole of the power supply and the signal output line. When the transistor is ON, the output voltage is close to the encoder power supply voltage, and when the transistor is OFF, the output voltage is close to 0 V.

What are rise time and fall time?

- Rise time: the time for the output pulse to rise from 10% to 90%.
- Fall time: the time for the output pulse to fall from 90% to 10%.



What are maximum response frequency and maximum allowed speed?

- The maximum response frequency is the maximum electrical response frequency of the encoder, in Hz. If it is used above this parameter, the internal circuit of the encoder will not respond, which will lead to encoder leakage pulse.
- The maximum allowed speed refers to the maximum rotation speed that the encoder shaft can bear when rotating, in r/min. If the actual speed is higher than this parameter, the shaft of the encoder will be damaged.

How far can the signal output of the rotary encoder be transmitted?

Depending on the encoder output type.

- Open-circuit collector NPN/PNP output: 10 m.
- Voltage output: 2 m.
- Complementary output: 30 m.
- Differential output (or line-driven output): 100 m.



- We recommend using differential output type (linear drive output type) encoder in the case of long distance transmission.
- If you want to extend the wire of the encoder, you must use a shielded twisted pair.

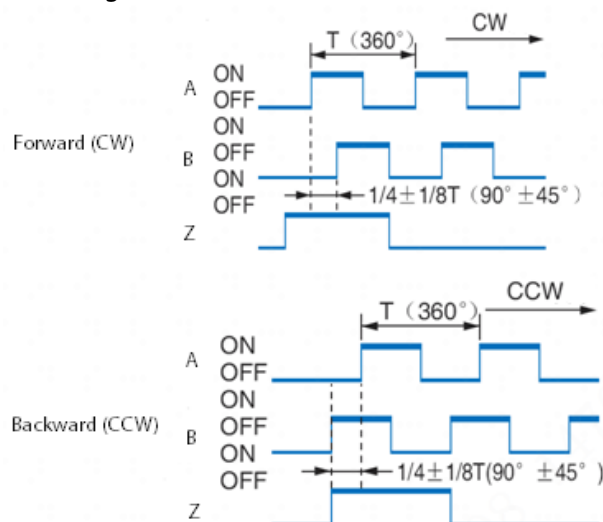
How to avoid encoder interference?

- Use shielded cables for signal cables, and connect them reliably.
- The signal wires are routed separately from high-current power cables (such as motor wiring).
- Install the device separately from high-power or high-frequency device.

What do phase A, phase B and phase Z output of the incremental encoder mean?

Each time the encoder rotates for one circle, phase A and phase B send out the same number of pulses, but there is a phase difference of 90° (360° after rotating a circle) between phase A and phase B, according to this phase difference, it can be judged whether the direction of the encoder rotation is forward or reverse. Phase output is performed when phase A advances phase B 90° during forward rotation, and phase output is performed when phase B advances phase A 90° (as shown in the following figure). Every time the encoder rotates, phase Z only sends out a pulse at a fixed position, so it can be used as a reset phase or a zero phase.

Figure 4-14 Phase difference



What is encoder resolution?

Resolution is also called the number of pulses. For an incremental encoder, resolution is the number of pulses output by the encoder after the shaft rotates one circle.

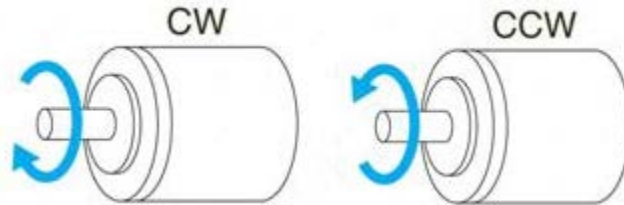
What is the output phase?

For incremental encoders, it refers to the number of output signals, and it includes 1-phase type (phase A), 2-phase type (phases A and B), 3-phase type (phases A, B, and Z).

What are CW and CCW?

CW is the direction of clockwise rotation as shown below. In this direction of rotation, the incremental type usually outputs phase A first compared to phase B. The opposite of CW is CCW (counter clockwise), in which incremental encoders usually output phase B before phase A.

Figure 4-15 description of CW and CCW



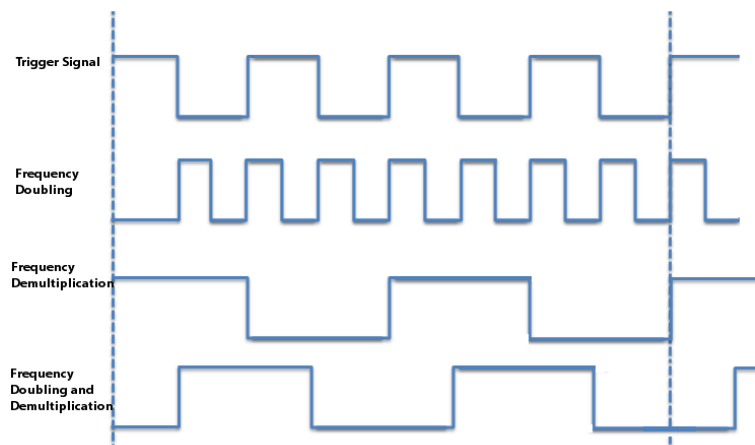
How to convert the signal output by NPN into the signal output by PNP?

Connect a pull-up resistor between the NPN output pin and the encoder power supply to output a low level when the transistor is on and a high level when the transistor is off. The value of pull-up resistor depends on the minimum turn-on voltage of the camera and the internal resistance of the input, generally 4.7 K–10 K.

4.4.3 Frequency division control

- The frequency division and multiplication functions of the CameraLink line scan camera can be realized by the frame grabber, and we recommend that the frequency division and multiplication coefficient should not be too large, otherwise the effect is prone to decline, for example, after multiplying the signal frequency, the frequency fluctuates too much.
- Manage the frequency division and multiplication function of the signal source. That is, slow down the signal source selected by frequency division, or speed up the signal source selected by frequency multiplication. It is mainly applied when the external signal triggers the camera to start working, due to the actual signal source pulse frequency and the shooting length within the object moving cycle, there is no completely positive match, resulting in poor image effect, serious stretching or compression. We can adjust the signal frequency to reduce or improve the camera line trigger frequency, to make the image display normal.

Figure 4-16 Frequency division



- The line height of the image is 2048, the theoretical line frequency is 28000, and the frame rate is 0.5 frames. The image is severely compressed. The line frequency of the trigger signal (2048) is less than the moving speed of the object and cannot be changed. The image can be adjusted by adjusting the frequency ratio.

Figure 4-17 Image compression



Set the value of **ShaftEncoderMultiplyFactor** to 3, to increase the signal frequency of the received encoder to 3 times, and increase the trigger emission frequency to $2048 \times 3 = 6144$.

- When the image is stretched, frequency division adjustment can be used: set the **ShaftEncoderMultiplyFactor** back to 1, set **ShaftEncoderDivisionFactor** to the corresponding value for frequency division. If it is set to 3, the signal frequency is reduced by 3 times.

Figure 4-18 Adjustment results



- Non-integer division frequency: if you want to multiply 1.5 times, you can set **ShaftEncoderDivisionFactor** to 2, and **ShaftEncoderMultiplyFactor** to 3, and vice versa.

4.5 Method control

Through this parameter, you can set the collection mode of the frame grabber.

Figure 4-19 Collection mode of frame grabber

AcquisitionControl	
FrameActive	False
FrameActiveTriggerSou...	{Not Available}
FrameActiveTriggerPola...	{Not Available}
FrameTimeout	0
ImageDiscard	False

Table 4-5 collection management properties

Parameter	Description
Frame Active	Variable frame switch to control the number of acquisitions via the frame duration signal.

Frame Active Trigger Source	Variable frame signal sources, provides 5 kinds of external trigger sources: ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, ExternalTrigger4, and Shaftencoder1.
Frame Active Trigger Polarity	Frame signal polarity setting: high level and low level.
Frame Timeout	Frame timeout: the parameter range is [0 μ s, 15000000 μ s], and the required time is greater than the interval between rows and lines.
Image Discard	Image discard switch.

4.5.1 Frame active

After receiving a high level (low level) signal, collect multiple rows within the effective range of the signal pulse width, and the number of directly collected rows meets the defined line height and the image is displayed, triggering the action ends. If no sufficient number of rows and heights are collected within the effective range of the signal pulse width due to the short width of the signal pulse, the image is directly generated according to the actual number of row heights collected.

- Step 1 Turn on **Frame Active**, select the external signal source of **Frame Active Trigger Source**, and set the high or low level triggering of the external signal through **Frame Active Trigger Polarity**.
- Step 2 Select external trigger source signal for **Strobe Method**. The source can be ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, ExternalTrigger4, and shaftencoder1.
- Step 3 For CC of OutputTriggerControl, select **StrobeMethod1** as the line signal to be sent to the camera.
- Step 4 For CC of OutputTriggerControl, select the external trigger source signal as the frame signal. The trigger source needs to be consistent with the external trigger source of **Frame Active Trigger Source**.
- Step 5 Set the FrameTimeout time. You must configure **Frame Timeout** when using the **Frame Active**.
- Step 6 Enable **Image Discard**. When the last frame image is smaller than the defined row height, the image is discarded. When image discard is not enabled, the image is displayed according to the actual row height.



This function requires the camera to use the row trigger mode, and does not need to turn on frame trigger.

4.5.2 Frame timeout

In the parameter of the frame grabber, the Acquisition Control--FrameTimeout parameter is designed for setting frame timeout. When the parameter value is set to 0, it indicates that frame timeout is not enabled. After the number of rows output by the camera reaches the defined image height, an image is output. When the number of output rows does not reach the image height, the row data is always waiting to reach the image height before outputting the image.

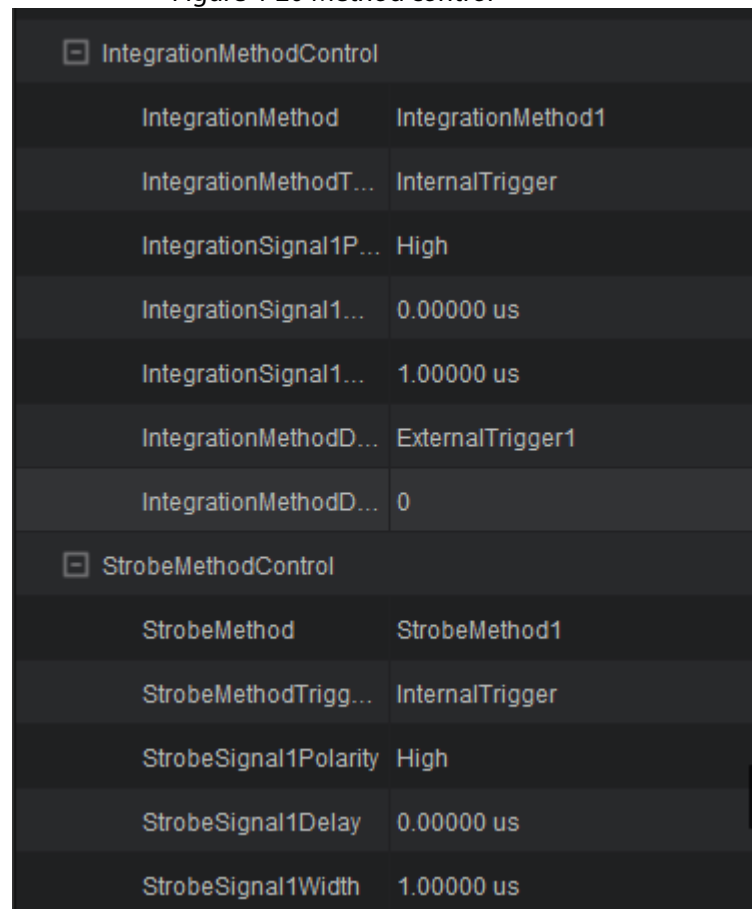
The value range of the current FrameTimeout is [0ms, 15000000us]. You can set the line-to-line interval waiting time through the FrameTimeout. If the interval between the rows exceeds the frame timeout, the remaining part will be blackened according to the defined row height, and the image will be output.



This function requires the camera to work in frame + line mode, and the Frame Active is turned off.

4.6 Method control

Figure 4-20 Method control



IntegrationMethodControl	
IntegrationMethod	IntegrationMethod1
IntegrationMethodT...	InternalTrigger
IntegrationSignal1P...	High
IntegrationSignal1...	0.00000 us
IntegrationSignal1...	1.00000 us
IntegrationMethodD...	ExternalTrigger1
IntegrationMethodD...	0
StrobeMethodControl	
StrobeMethod	StrobeMethod1
StrobeMethodTrigg...	InternalTrigger
StrobeSignal1Polarity	High
StrobeSignal1Delay	0.00000 us
StrobeSignal1Width	1.00000 us

Table 4-5 Method control parameters

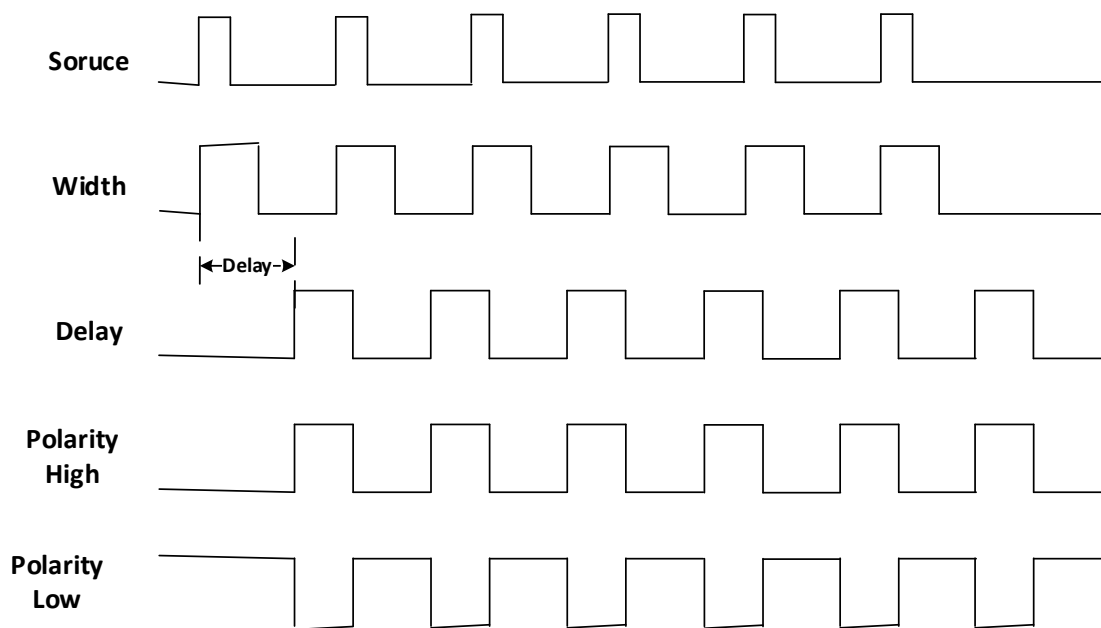
Parameter	Description
Integration Method Trigger Source	InternalTrigger, ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, ExternalTrigger4, ShaftEncoder1.
IntegrationSignal1Polarity	Integration signal level setting: high level, low level.
IntegrationSignal1Delay	Integration signal delay setting: parameter range [0 μ s, 1000000 μ s].
IntegrationSignal1Width	Set the pulse width of the integration signal: parameter range [0 μ s, 1000000 μ s].
Integration Method Discard Trigger Source	InternalTrigger, ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, ExternalTrigger4, ShaftEncoder1.
Integration Method Discard Count	Set the number of signal discarded: parameter range [0, 16777215]
StrobeMethod	Flashing light control method.
StrobeMethodTriggerSource	InternalTrigger, ExternalTrigger1, ExternalTrigger2, ExternalTrigger3, ExternalTrigger4, ShaftEncoder1.
StrobeSignal1Polarity	Level setting: high level, low level.
StrobeSignal1Delay	Delay setting: parameter range [0 μ s, 1000000 μ s].
StrobeSignal1Width	Pulse width setting: parameter range [0 μ s, 1000000 μ s].

The MethodControl of the frame grabber provides 2 kinds of control signal methods, which are used with integration trigger signal and external I/O signal. Through parameter setting, a variety of control signals can be generated, and they can be applied to control the pulse width exposure of the camera, the external flash lamp, and more.

Control Method 1 and flash control method can produce signals that can be defined, which are generated as the trigger signal source, and can be used to manually set width (pulse width), delay,

and polarity. Through control method 1, you can set the number of discarded signals, which can be applied to unstable external initial signals.

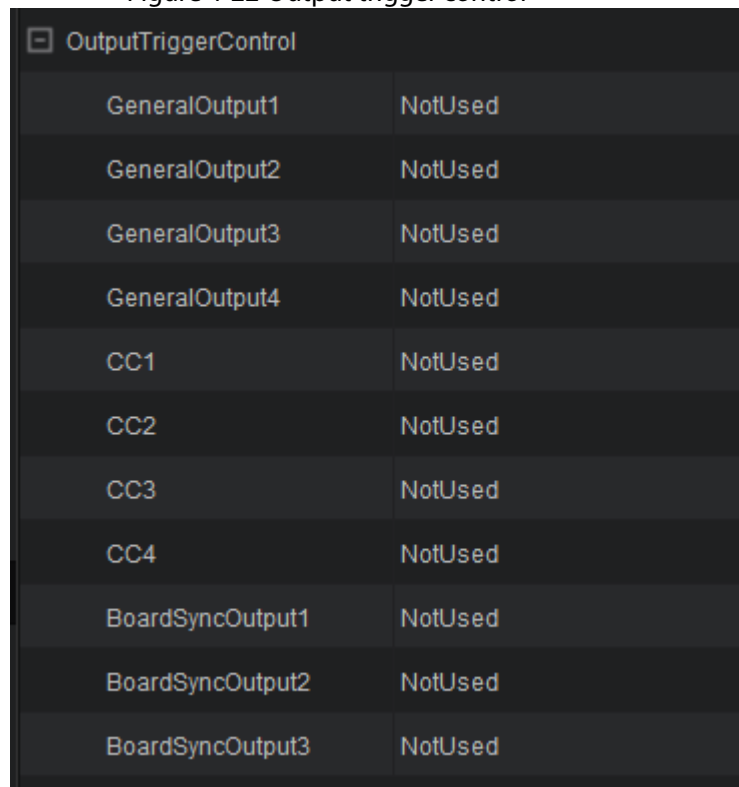
Figure 4-21 Frame grabber control method



- Step 1 Select signal source for **Trigger Source**, and then select external signal and internal trigger signal.
- Step 2 Set the polarity of the integration signal in **Integration Signal1 Polarity**, and the output pulse signal can be set to high or low level.
- Step 3 Set the pulse width and delay of the integration signal in **Signal1 Width** and **Signal1 Delay**.
- Step 4 For **CC** in **OutputTriggerControl**, select **Integration Method1** as the CC signal to be sent to the camera, which is used to control the pulse width exposure of the camera. Select **Strobe Method** from **General Output**, which can be sent to the external light source controller, and thus controlling the flashing light.

4.7 Output trigger control

Figure 4-22 Output trigger control



OutputTriggerControl	
GeneralOutput1	NotUsed
GeneralOutput2	NotUsed
GeneralOutput3	NotUsed
GeneralOutput4	NotUsed
CC1	NotUsed
CC2	NotUsed
CC3	NotUsed
CC4	NotUsed
BoardSyncOutput1	NotUsed
BoardSyncOutput2	NotUsed
BoardSyncOutput3	NotUsed

Table 4-6 Output trigger control parameters

Parameter	Description
General Output1	External output 1, corresponding to I/O port OPT_OUT1.
General Output2	External output 2, corresponding to I/O port OPT_OUT2.
General Output3	External output 3, corresponding to I/O port OPT_OUT3.
General Output4	External output 4, corresponding to I/O port OPT_OUT4.
CC1	Camera Link interface camera control channel 1.
CC2	Camera Link interface camera control channel 2.
CC3	Camera Link interface camera control channel 3.
CC4	Camera Link interface camera Control Channel 4.
Board Sync Output1	Synchronize I/O port 1, corresponding to synchronize I/O output 1.
Board Sync Output2	Synchronous IO port 2, corresponding to synchronous IO output 2.
Board Sync Output3	Synchronous IO port 3, corresponding to synchronous IO output 3.

The output trigger control module includes general output, camera control signal output and synchronous output between boards. The details are as follows:

- Set **GeneralOutput** to output signals to external control device, such as light source controller, PLC. The available signal sources include InternalTrigger, ExternalTrigger, ShaftEncoder, SoftwareTrigger, ExternalBoardSync, IntergrationMethod, StrobeMethod, DifferinputChA, DifferinputChB, FrameEnd. In the actual operation process, make sure that the panel trigger interface is connected correctly. For details of 26 pins, see "3.1Panel trigger interface description".



In dual-base mode, General Output1 and General Output2 of CameraLink#Port0 correspond to I/O port OPT_OUT1 and I/O port OPT_OUT2. General Output1 and General Output2 of CameraLink#Port1 correspond to I/O port OPT_OUT3 and I/O port OPT_OUT4.

- Set the CameraLink signal source supported by the CameraLink protocol to CC1, CC2, CC3, and CC4. The available signal sources include InternalTrigger, ExternalTrigger, ShaftEncoder, SoftwareTrigger, ExternalBoardSync, IntergrationMethod, StrobeMethod, DifferinputChA,

DifferinputChB and FrameEnd. The signal source of the frame grabber must be consistent with the camera trigger source (**Camera Properties > AcquisitionControl > TriggerSource**).

- Set the signal source of the multi-card synchronous signal channel. This parameter can only be set in the main card. When the frame grabber is set to the sub card, this parameter is **NotUsed** by default. The signal sources that can be selected for multi-card synchronization include InternalTrigger, ExternalTrigger, ShaftEncoder, SoftwareTrigger, ExternalBoardSync, IntergrationMethod, StrobeMethod, DifferinputChA, DifferinputChB, and FrameEnd.

The frame grabber provides 3 two-way I/O interfaces (BoardSync1, BoardSync2, and BoardSync3) to solve the problem that the trigger signals between multiple frame grabbers in the same industrial PC can be synchronized in real time. The multi-card synchronization signal can be used as input signal or output signal, and the multi-card synchronization line of accessories between the card and the card can be connected when used.

Step 1 Select the main-sub mode from **BoardSyncMode** of **ExternalTriggerControl**, and set the main card and the sub card.

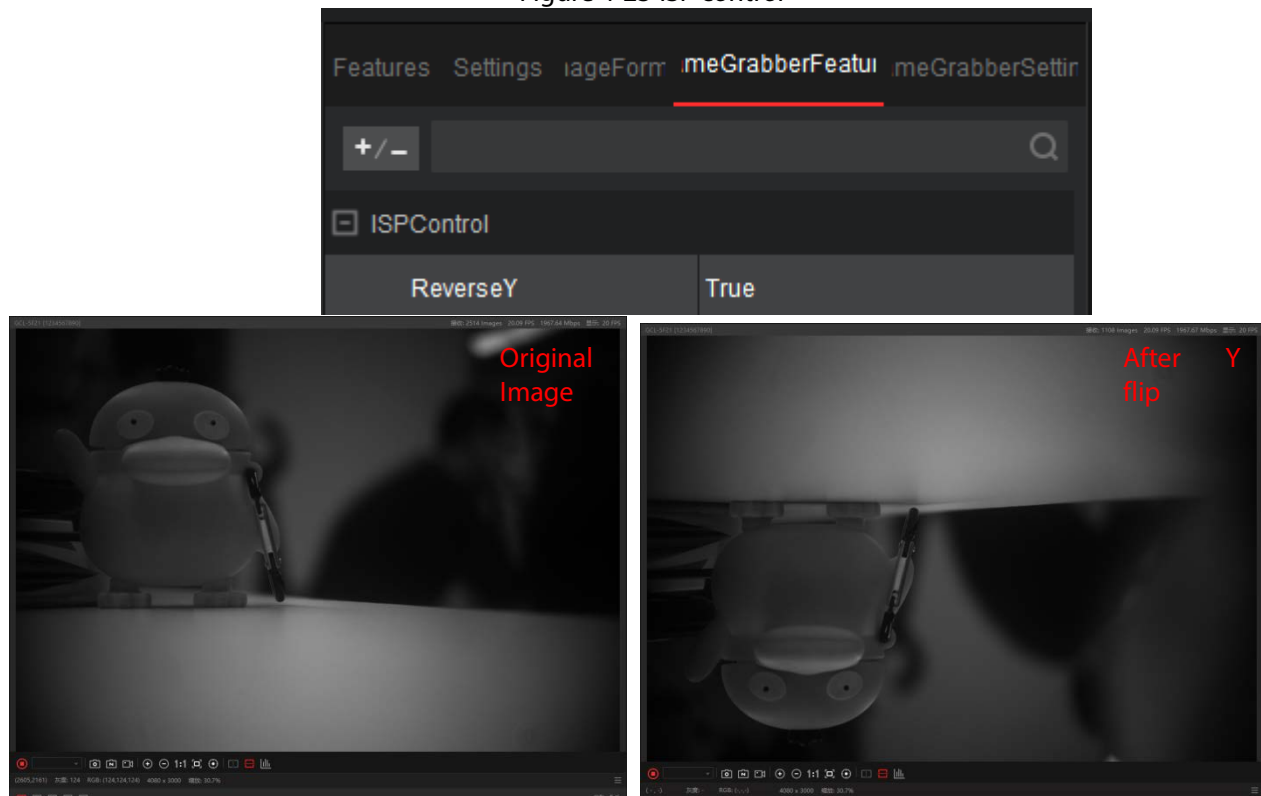
Step 2 Set the signal source of **boardSyncOutput** in the main card **OutputTriggerControl**.

Step 3 Set the CC1-CC4 signal source of the sub card **OutputTriggerControl**, select **ExternalBoardSync**, and synchronize the output signal of the main card.

4.8 ISP control

Enable this parameter to flip the Y direction of the collected image.

Figure 4-23 ISP control



4.9 Statistics control

Figure 4-24 Statistics control

StatisticsControl	
InputStatisticsSource	ExternalTrigger4
InputCount	0
InputFrequency	0.00000 Hz
InputMinInterval	0.00000 us
InputStatisticsReset	{Command}
OutputStatisticsSource	CC1
OutputCount	0
OutputFrequency	0.00000 Hz
OutputStatisticsReset	{Command}
FrameRate	0.00000 Hz
FrameCount	89,114
LineCount	403,726,925,825
FrameCountReset	{Command}
ShaftEncodeCompens...	0
WRFrameCount	116,552
RDFrameCount	115,670
WRLineCount	115,135,603
PCBaseCount	4
DDRBuffCount	0
DDRStatisticsReset	{Command}
VerticalResolution	2,999
HorizontalResolution	4,080

Table 4-6 Introduction to statistical control parameters

Parameter	Description
Input Statistics Source	Input statistics source.
InputCount	Input statistics.
InputFrequency	Input frequency.
InputMinInterval	Minimum input interval.
Output Statistics Source	Output statistics source.
OutputCount	Output statistics.
OutputFrequency	Output frequency.
Shaft Encode Compensation Count	Encoder compensation count.
FrameCount	Frame statistics.
LineCount	Line statistics.

WRFrameCount	Frame statistics (write).
RDFrameCount	Frame statistics (read).
WRLineCount	Row statistics (write).

4.10 User set control

Figure 4-25 User set control

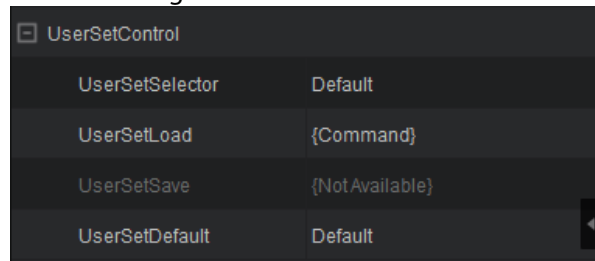


Table 4-7 User set control parameters

Parameter	Description
UserSetSelector	Select user setting group. Currently, Default, Youet1, and Youet2 are supported. Select which group to use for subsequent UserSetLoad and UserSetSave operations.
UserSetLoad	Restore the camera configuration to the configuration selected by the user.
UserSetSave	Save the current configuration to the selected group. Default groups cannot be saved.
UserSetDefault	The default user settings after power-on. UserSet1 and UserSet2 need to perform UserSetSave before they can be displayed here.

A1- Histogram

In MV software, click **Histogram** in the lower-right column of the image window, and then you can view the statistical histogram of the current image grayscale value in real time.

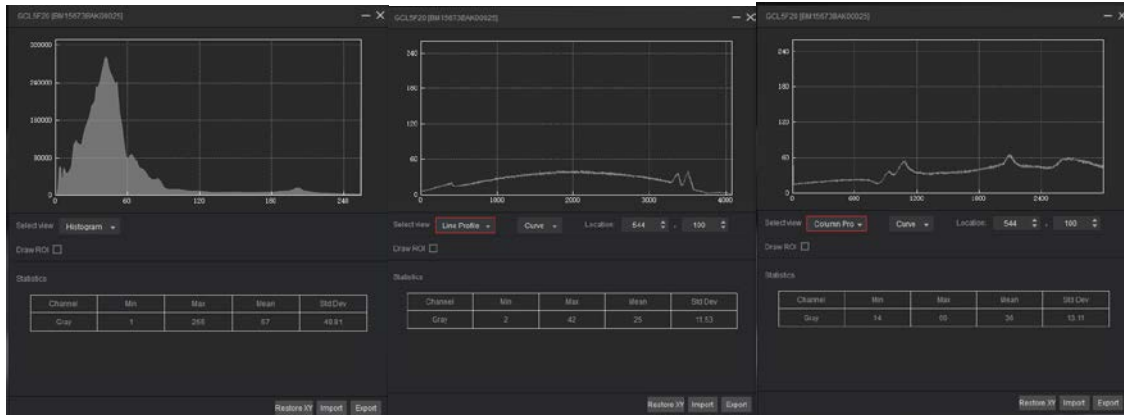
The horizontal axis of the histogram corresponds to the gray value, and the vertical axis corresponds to the number of pixels. Select the ROI that have been drawn, and then the histogram will be automatically embedded.

Figure 4-26 ROI embedding effect



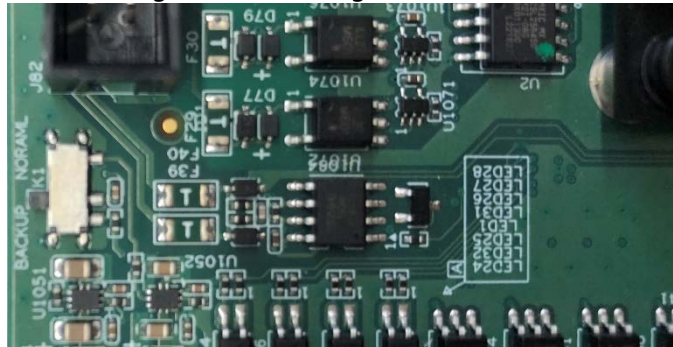
In the **View** drop-down list, select **Line Profile** and **Column Profile** to be counted. The statistics page includes the minimum, maximum, average, and standard values of the gray channel.

Figure 4-27 ROI square diagram



A2-Backup

Figure 4-28 Frame grabber

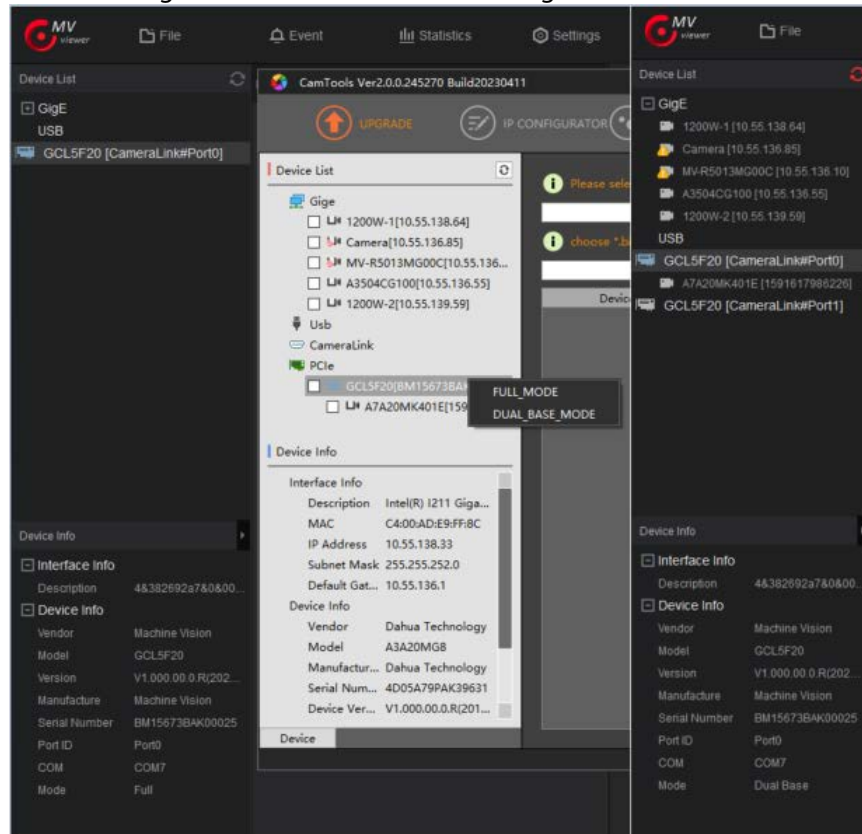


You cannot start the frame grabber normally due to power failure or other abnormal operations during the upgrade process. In this case, you can restore the source program through backup.

- Step 1** Power off the industrial PC installed on the frame grabber. After power off, find the dial switch on the grabber, and turn it to the backup status (the original factory setting is **Normal**).
- Step 2** Power on the machine, turn on the MV Viewer to check that the frame grabber starts, upgrade the frame grabber in the backup state, and shut down the computer after the upgrade is completed.
- Step 3** Restore the dial switch to the **Normal** state, start the computer, and the frame grabber can work normally.

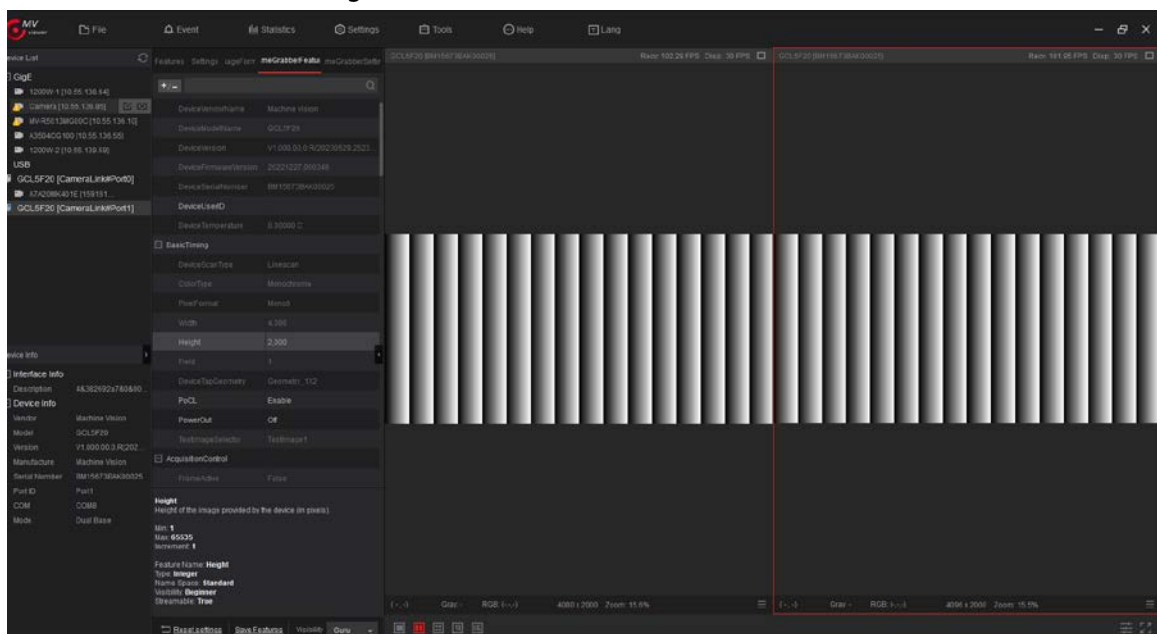
A3-Switch mode of frame grabber

Figure 4-29 Switch mode of frame grabber



- View mode: Select the current frame grabber, and view the frame grabber mode in the device information on the lower-left side of the MV-Viewer.
- Switch mode: Disconnect the link status of the frame grabber, and select **Tools > Frame grabber camera tools** in the menu bar. Select the frame grabber to be upgraded, right-click the frame grabber mode (**dual-Base** or **Full**) to be changed, and then re-open the MV after the change.

Figure 4-30 Effect of dull-base mode



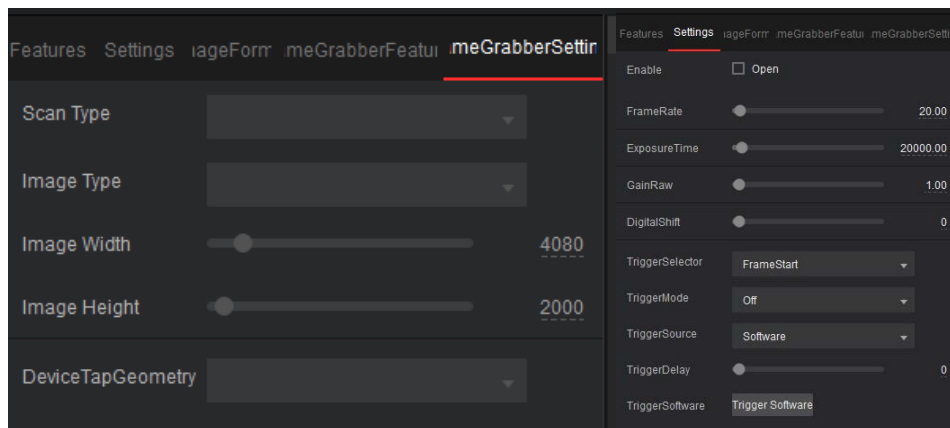
When the frame grabber is switched to dual-base mode, the frame grabber CL1 and CL2 are connected to camera 1 CL1 and camera 2 CL1 respectively.

A4-Common Parameters of Frame grabber

To facilitate quick debugging, you can choose to directly edit the common parameters of the frame grabber, including camera scanning type, image type of the frame grabber, image width, image height, the number of Tap and arrangement.

The common parameters of the frame grabber must be consistent with that of the available camera parts.

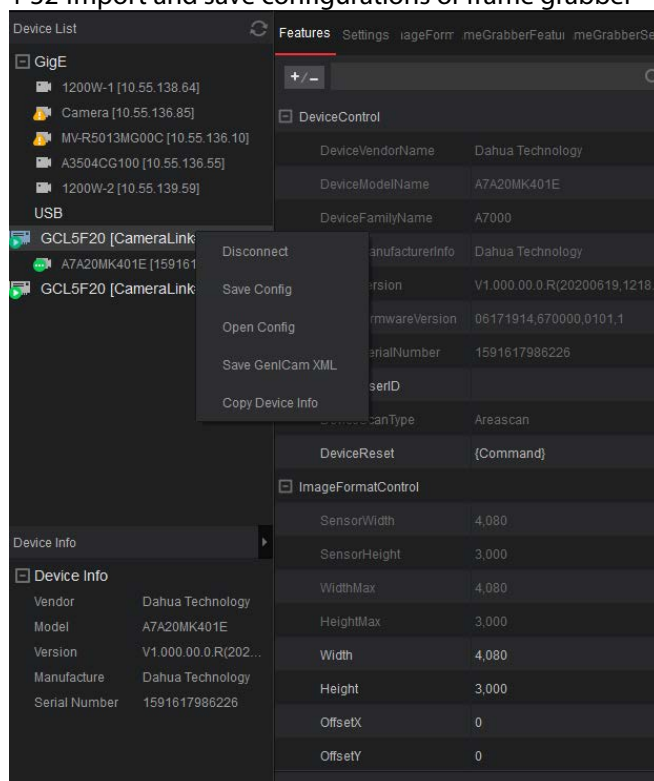
Figure 4-31 Common parameters



A5-Import and export of frame grabber configuration

In the actual debugging process, to quickly import the relevant parameters of the frame grabber, you can right-click the target frame grabber to save the current configuration file and open the target configuration file to complete the parameter configuration.

Figure 4-32 Import and save configurations of frame grabber



5 FAQ

5.1 Frame grabber recognition

5.1.1 The device manager cannot recognize the frame grabber driver

- Check whether the image device in the device manager has **Frame Grabber Device**. If not, install the driver PCIeCLDriver.
- If the driver is not enabled, restart the computer after starting the driver.
- Troubleshoot device manager > other devices, to see whether unknown devices are not installed. If not, check the PCIe card slot identification. You can re-plug and unplug the frame grabber or replace other PCIe card slots.

5.1.2 The frame grabber cannot recognize the camera

- Check whether the port in the device manager has a **MV Virtual Serial Port**. If not, install the driver CLVSPDriver.
- Check whether CL1 and CL2 are reversely inserted, which can be confirmed through the indicator of the frame grabber.
- Check whether insert the grabber first, and then install the driver. If not, you need to reinstall the driver. Add the frame grabber to the card slot, and then reinstall the serial port driver.
- Check whether the camera or frame grabber is occupied by other processes. Check it through the task manager and turn it off. If it cannot be confirmed, turn off the computer and restart it after power failure.
- Check whether the camera indicator is in the normal starting state. Generally, after the CameraLink camera is started, the blue light flashes quickly.

5.1.3 The frame grabber cannot be connected to the camera

- Check whether the serial port number in the lower-left corner of the MV is normal. If an exception occurs, uninstall the driver again, and install the driver CLVSPDriver and PCIeCLDriver.

Figure 5-1 COM port

Port ID	Port0
COM	COM7
Mode	Dual Base

- Check whether the local xml file is damaged. Delete all files in the C:\ProgramData\GenlCam\xml path.
- Check whether the frame grabber software is turned on, and the camera xml is occupied.

5.2 Frame grabber output problem

5.2.1 Free stream pulling cannot be output

- Check whether the camera indicator flashes blue.
- Open the **Test Image Selector** of the frame grabber. If the outgoing stream is available, it indicates that there is no problem at the frame grabber end. If the outgoing stream is not available, power off and shut down the computer and restart it to check again, check whether

the test chart of the frame grabber is normal, and then check the **Test Image Selector** of the camera property to check whether the outgoing stream can be normal. If the outgoing image can be normal, it indicates that there is no problem with the camera to the frame grabber wiring.

- Check whether MV prompts a stream pulling error. If such an error is displayed, check whether the remaining memory of the computer is too small, or the computer memory is occupied by other applications. After restarting the computer, turn on MV first, and then set the maximum width and height. If the stream cannot be pulled, you need to increase the computer memory.
- Open the settings to view the cache of the stream data. When you use the frame grabber to take a snapshot, the number of caches cannot be less than 2. If you set this parameter to 1, the image cannot be output.

5.2.2 The external trigger cannot be displayed

- Check the Input Count under the parameter **StatisticsControl** to check whether the external signal is normal. If the value is abnormal, check the external signal source, whether the cable is connected incorrectly, check whether the external trigger **TriggerControl** is set incorrectly outside the frame grabber or whether the filter parameters on the frame grabber are set abnormally.
- Check the **Output Count** under the parameter **StatisticsControl**, to confirm whether the signal sent to the camera by the frame grabber is normal. If the value is abnormal, troubleshoot the **OutputTriggerControl** to see whether the signal source is correctly selected.
- Check whether the **FrameTriggerCount** and **LineTriggerCount** under the **Port Layer Control** in the camera properties have values. If the values are abnormal, check whether the filter parameter settings on the camera are too large.
- Check whether the **WR Frame Count** and **WR Line Count** under the parameter **StatisticsControl** are increased. If not, it indicates that there is a problem between the camera and the frame grabber, which needs to be troubleshooted by free stream pulling.
- Check whether the line frequency of the external signal exceeds 333 K. If the line frequency exceeds 333 K, contact technical support.

5.2.3 The number of external triggers is inconsistent with the theoretical frame rate after external signals are calculated

- Check whether the row height settings of the frame grabber and the camera are consistent. Inconsistency will lead to the actual frame rate calculation problem.
- If the number of output images is greater than the frame rate of external signals, check whether the **Input Count** is calculated under the parameter **StatisticsControl** of the frame grabber. If the number of external signals is exceeded, it means that there are noise waves in the trigger line, and the filtering parameters of the large frame grabber terminal need to be set.
- If the number of output images is less than the frame rate of external signals, check whether the **Input Count** is calculated under the parameter **StatisticsControl** of the frame grabber. If it is less than the number of external signals. If it is less than or equal to 0, it means that the filtering parameters are too large, and the normal pulse signal is filtered out, the filtering parameters of the frame grabber need to be reduced.
- Check whether the frequency of external signals exceeds the row frequency (frame rate) of the camera, which can be improved by reducing the exposure time.

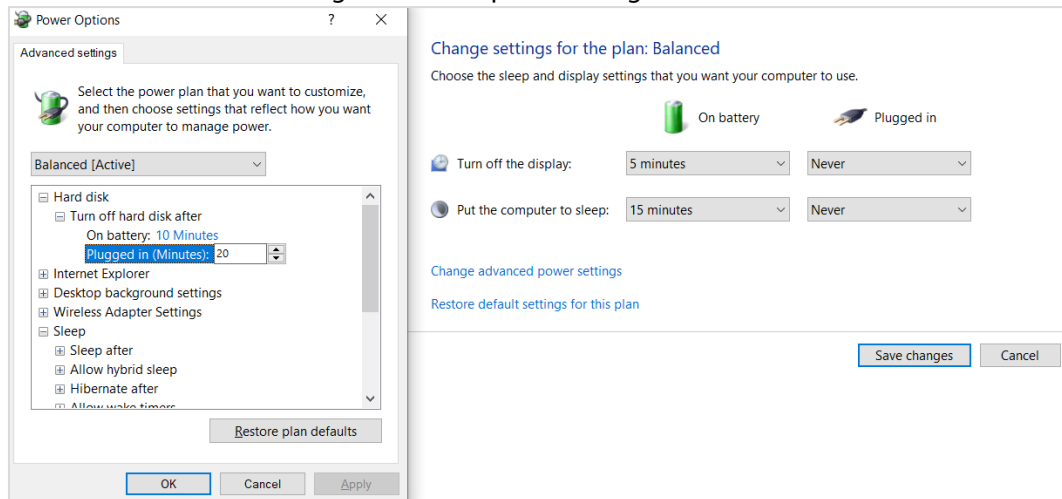
The camera parameter settings read slowly

- Check the camera property **Baud Rate** and the baud rate setting. We recommend increasing the baud rate to 115200 or 460800, because the baud rate of the camera cannot be saved. You need to reset it every time you restart the camera.
- Replacing the poor cable will easily lead to abnormal communication or image abnormalities.

5.3 The frame grabber is abnormal after the computer is locked

- Check the indicator of the frame grabber. If the indicator is not on, it means that the frame grabber is powered off, and the computer needs to be powered off and then restarted. By checking whether the power supply settings of the computer enter the configuration, you need to set the computer to not sleep, and do not close the hard disk.
- If the indicator is on normally, it means that the driver is abnormal. You need uninstall and install the frame grabber driver again to restore it. By checking whether the computer power settings enter the configuration, you need to set the computer to not sleep and do not close the hard disk.

Figure 5-2 Computer settings



5.4 Upgrade

Firmware versions of the same model can be upgraded to each other at will. Do not forcibly upgrade versions of different models, which may cause program and frame grabber mismatch, function shortage or frame grabber unavailability.

5.4.1 Frame grabber upgrade

- After upgrading the frame grabber, you need to power off, shut down, and then restart the computer. The frame grabber program will not be upgraded if you restart the computer directly.
- When the version of the frame grabber program is upgraded from April 2023 to April 2023, you need to select **boot** for successful upgrade.

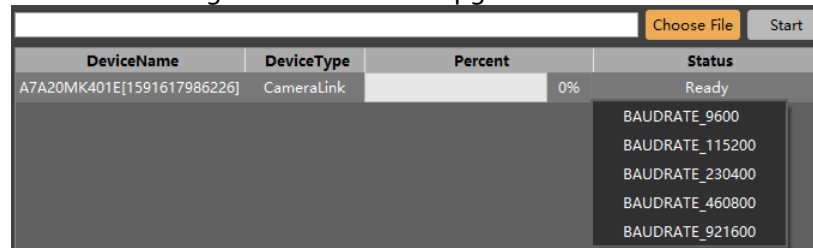
Figure 5-3 Upgrade the frame grabber



5.4.2 CL camera upgrade

When the CameraLink camera is upgraded, we recommend that you set the baud rate to 460800, which can improve the upgrade speed to the greatest extent. During the upgrade process, double-click the progress bar to see logs about whether the baud rate is successfully issued, flash status, and more.

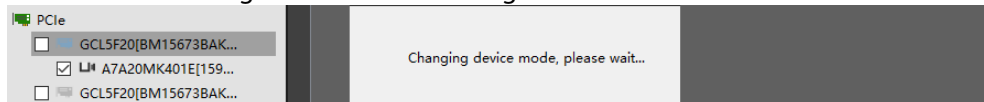
Figure 5-4 CL camera upgrade



5.5 Full and dual-base switching

When you switch the full mode to the dual-base mode for the frame grabber in the Cameratools, we recommend that you wait for 5 seconds to close the Cameratools after the prompt ends.

Figure 5-5 Switch frame grabber mode



6 Accessory

The accessories of the frame grabber include: CameraLink cable, board sync lines, DB26 I/O special line, and IO adapter plate.

CamraLink cable

Provides common cables (3, 5, 7 meters) and optical fiber lines of different lengths, and uses SDR interfaces.

Figure 6-1 CameraLink cable



Board sync lines

Provides board sync lines with different ports to realize multi-card signal synchronization. Multi-card sync lines adopt 6-pin cable connection.

Figure 6-2 Multi-card synch lines



DB26 I/O special wire + IO adapter plate

Provides standard DB26 port adaptive I/O cables, which can be divided into 2 types: one is DB26 heads with 2 ends, and needs to be used with I/O adapter plate; the other one is DB26 at one end, and bare cable at the other end. Bare cable can be directly connected to external sensors.

Figure 6-3 DB26 I/O cable



Figure 6-4 DB26 I/O adapter plate



Figure 6-5 DB26 I/O bare wire



Table 6-1 Cable description

Line No.	Color	Line No.	Color	Line No.	Color
1	Light Blue	2	Line green	3	Pink

4	White	5	Gray	6	Blue
7	Purple	8	Yellow	9	Green
10	Gray/Black	11	Brown/Black	12	White/Black
13	Red/Black	14 mm	Purple/black	15	Blue/Black
16	Green/Black	17	Yellow/Black	18	Orange/black
19	Black	20	Brown/white	21	Yellow/white
22	Green/white	23	Orange/white	24	Brown
25	Orange	26	Red		

Appendix 1 Cybersecurity recommendations

Mandatory actions to be taken for basic device network security:

1. Use Strong Passwords

Please refer to the following suggestions to set passwords:

- The length should not be less than 8 characters.
- Include at least two types of characters; character types include upper and lower case letters, numbers and symbols.
- Do not contain the account name or the account name in reverse order.
- Do not use continuous characters, such as 123, abc, etc.
- Do not use overlapped characters, such as 111, aaa, etc.

2. Update Firmware and Client Software in Time

- According to the standard procedure in Tech-industry, we recommend to keep your device (such as NVR, DVR, IP camera, etc.) firmware up-to-date to ensure the system is equipped with the latest security patches and fixes. When the device is connected to the public network, it is recommended to enable the “auto-check for updates” function to obtain timely information of firmware updates released by the manufacturer.
- We suggest that you download and use the latest version of client software.

"Nice to have" recommendations to improve your device network security:

1. Physical Protection

We suggest that you perform physical protection to device, especially storage devices. For example, place the device in a special computer room and cabinet, and implement well-done access control permission and key management to prevent unauthorized personnel from carrying out physical contacts such as damaging hardware, unauthorized connection of removable device (such as USB flash disk, serial port), etc.

2. Change Passwords Regularly

We suggest that you change passwords regularly to reduce the risk of being guessed or cracked.

3. Set and Update Passwords Reset Information Timely

The device supports password reset function. Please set up related information for password reset in time, including the end user's mailbox and password protection questions. If the information changes, please modify it in time. When setting password protection questions, it is suggested not to use those that can be easily guessed.

4. Enable Account Lock

The account lock feature is enabled by default, and we recommend you to keep it on to guarantee the account security. If an attacker attempts to log in with the wrong password several times, the corresponding account and the source IP address will be locked.

5. Change Default HTTP and Other Service Ports

We suggest you to change default HTTP and other service ports into any set of numbers between 1024–65535, reducing the risk of outsiders being able to guess which ports you are using.

6. Enable HTTPS

We suggest you to enable HTTPS, so that you visit Web service through a secure communication channel.

7. MAC Address Binding

We recommend you to bind the IP and MAC address of the gateway to the device, thus reducing the risk of ARP spoofing.

8. Assign Accounts and Privileges Reasonably

According to business and management requirements, reasonably add users and assign a minimum set of permissions to them.

9. Disable Unnecessary Services and Choose Secure Modes

If not needed, it is recommended to turn off some services such as SNMP, SMTP, UPnP, etc., to reduce risks.

If necessary, it is highly recommended that you use safe modes, including but not limited to the following services:

- SNMP: Choose SNMP v3, and set up strong encryption passwords and authentication passwords.
- SMTP: Choose TLS to access mailbox server.
- FTP: Choose SFTP, and set up strong passwords.
- AP hotspot: Choose WPA2-PSK encryption mode, and set up strong passwords.

10. Audio and Video Encrypted Transmission

If your audio and video data contents are very important or sensitive, we recommend that you use encrypted transmission function, to reduce the risk of audio and video data being stolen during transmission.

Reminder: encrypted transmission will cause some loss in transmission efficiency.

11. Secure Auditing

- Check online users: we suggest that you check online users regularly to see if the device is logged in without authorization.
- Check device log: By viewing the logs, you can know the IP addresses that were used to log in to your devices and their key operations.

12. Network Log

Due to the limited storage capacity of the device, the stored log is limited. If you need to save the log for a long time, it is recommended that you enable the network log function to ensure that the critical logs are synchronized to the network log server for tracing.

13. Construct a Safe Network Environment

In order to better ensure the safety of device and reduce potential cyber risks, we recommend:

- Disable the port mapping function of the router to avoid direct access to the intranet devices from external network.
- The network should be partitioned and isolated according to the actual network needs. If there are no communication requirements between two sub networks, it is suggested to use VLAN, network GAP and other technologies to partition the network, so as to achieve the network isolation effect.
- Establish the 802.1x access authentication system to reduce the risk of unauthorized access to private networks.
- Enable IP/MAC address filtering function to limit the range of hosts allowed to access the device.